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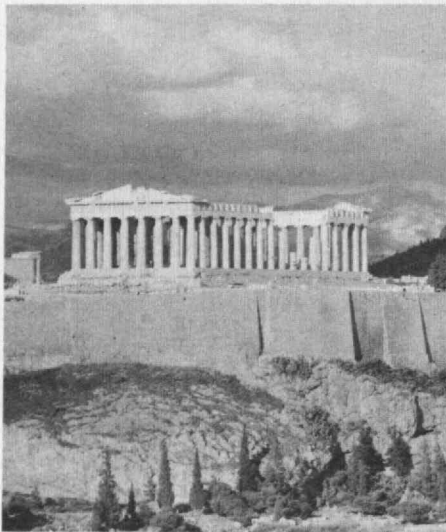


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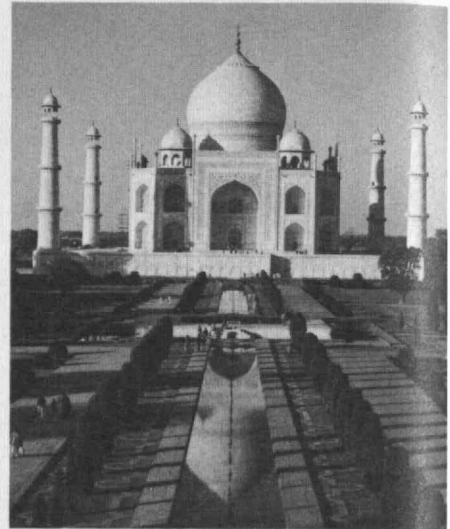


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* * *

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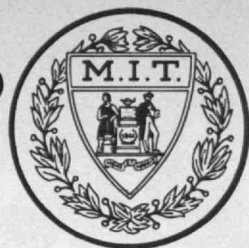
Individual brochures on each tour are available, setting forth the detailed itinerary, departure dates, hotels used, and other relevant information. Departure dates for 1975 are also available.

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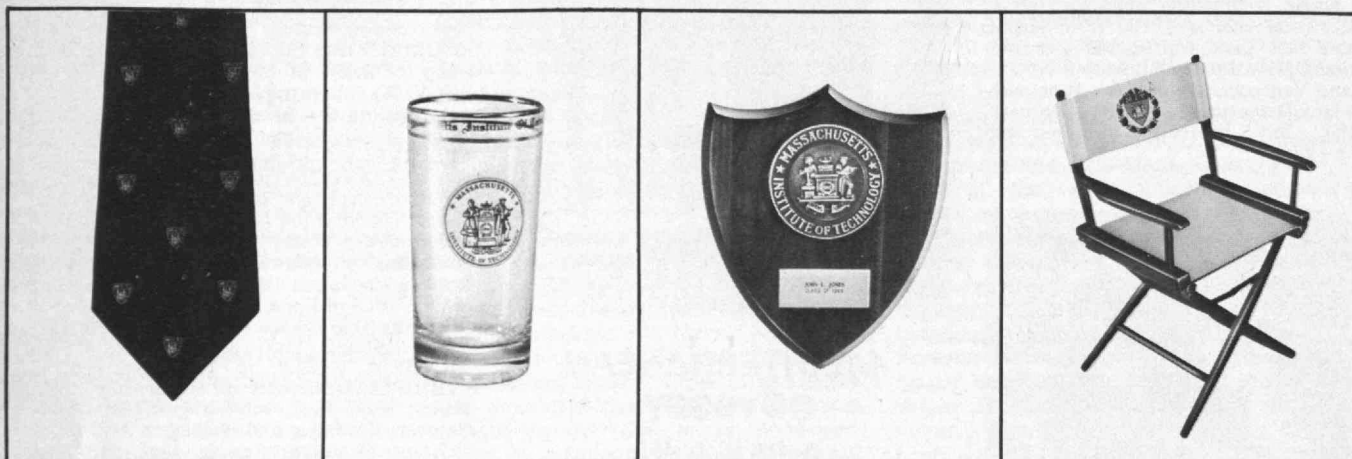
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Resource Planning for Urban Public Safety Systems 20 Richard C. Larson

Here is a new model with which to attack the dilemma of shrinking urban resources and rising needs for service

Public Markets: Growth Opportunities and Environmental Improvement 30 James Brian Quinn

Environmental quality is consistent with economic growth; it represents a new market with new profit potentials

Tunneling the Channel 40 Frank P. Davidson

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World Peace: Action, Not Just "Pious Aspirations"

Kurt Waldheim, Secretary General of the United Nations, writes in *Technology Review* (June, 1973, pp. 73-74) to urge "a more human, compassionate, and practical involvement in the well-being of our fellow residents on our planets. We are, in every respect, interdependent. Let us recognize the fact in our actions and not merely in pious aspirations."

Many professional people reach their 50s or early 60s with enough money to do almost anything they want. They would like to retire, but they know they have too much energy—mental and physical—to just garden and play golf or fish. Frankly, they suddenly realize that retiring is one of the biggest challenges of life. It is hard to find a "retirement" program which deserves pride and which is a lot of fun.

Now if 50 or 100 such people with their special skills should move singly or in twos or threes to less developed countries, start up small businesses which fit into the particular economy, and then, as soon as practical, turn them over to local people—this might be worthwhile "action and not merely pious aspirations." The various businessmen doing this type of work might even help each other.

Let me give you a practical example.

In October, 1970, I retired from business life in the Boston area and moved to Grenada in the West Indies. This island is beautiful but very poor. It has many idle people who do not know how to use the natural resources of the island. I looked around for a challenging new job which involved making good use of some local material which was not being used. It turned out that I decided to find out if there was usable clay on the island which could be made into pottery, floor tiles, roof tiles, and sewer pipe.

I have never had any training or experience in this field. But I can assure you that I have had a lot of fun and made some progress in the last two and a half years. Now there are quite a few people on the island who see the possibility of using the local clays. I hope to have a small factory going in the next year and, if my plans work out, the new company will be about 80 per cent locally owned.

This work has been very satisfying. I have never had more fun in my life. There is plenty to do in this field for the next 20 or 30 years, if God gives me the time.

What do you think Mr. Waldheim would think of a number of individual efforts of this kind?

Johan M. Andersen
St. George's, Grenada, W. I.

Coal: "Perfect Storage" Underground

I do not understand Kenneth J. Epstein's letter, "Saving Coal for the Future" (*October/November, 1973, p. 80*). Coal is not particularly good for storing. Local generating power plants may have a six-month supply stored, but this amount must be carefully levelled and packed to prevent openings or rough edges where air can

cause spontaneous combustion. Small quantities of coal exposed to air will lose gases and much heating value. If coal is left exposed to the weather for long periods it loses most of its value.

If Mr. Epstein is concerned about preserving the coal mining industry he should work to prevent unwise government regulations from making it impossible for the industry to operate. Leave the coal in perfect storage until needed.

James F. Jackson
Carlisle, Ind.

Equipment in an Earthquake

Professor James H. Williams' treatment of "isolation mechanisms" (see "*Designing Earthquake-Resistant Structures*," *October/November, pp. 36-43*) is of particular and vital interest. Perhaps this should be even more closely coupled with the concept of lateral restraints, with reference not only to structures but also to their contents—particularly in industry, where boilers, pressure vessels, and mechanical and electrical equipment are involved.

The design of such objects to resist lateral forces in seismic areas has been largely ignored by most mechanical engineers. For example, little if any research has been done on what might happen if a large, heavy, high-speed rotating machine, such as a turbo-generator running under full load, should suddenly be subjected to oscillatory lateral forces, peaking out at an acceleration of perhaps 0.5 g. It is about time that our branch of the profession came to grips with problems of that sort; possibly the rotating machine example would be a timely subject for a doctoral thesis.

Herbert F. Lewis
Barrington, R.I.

Air Quality as "Preventive Medicine"

In "Air Pollution vs. Food Production" (*January, p. 5*), Ian C. T. Nisbet cites economic arguments which are really pure conjecture. He says it is ironic that emission standards are being relaxed for short-term expediency. A better argument would be that emission standards were set in great haste, with limited data, using an over-conservative "preventive medicine" philosophy that was known to be faulty at the time. It is the long-term seriousness of our energy problems and our belated public awareness of them that may result in rewriting of our emission standards. The primary air quality standards are not the subject of the current debate. And no one is arguing that the desolation of Sudbury, Ontario, should be condoned.

It is going to be difficult for people to accept that some of our environmental regulations may be faulty, because they were based more on a desire to be the "most progressive" state in the U.S. or to "keep industry's feet to the fire," rather than a careful study of the impact on the total system.

A. D. Rossin
Naperville, Ill.

Dr. Nisbet responds:

It is totally wrong to state that emission standards were set in great haste. They

were set after a lengthy period of review, publication of criteria, and public hearings in which industry and the utilities had ample opportunity to make their views felt. I thoroughly agree that they were set with limited data, especially on the damage to vegetation and crops which was the principal subject of my article. However, this does not mean that they were "over-conservative." Existing secondary ambient air quality standards are so high that they permit even acute injury to economically valuable plants. The more that we learn about sublethal effects on plant growth, crop yields, and resistance to disease, the better we realize that existing standards are in fact "over-liberal." I had no space to document my article, but a handy source of references on this subject is *Air Pollution Damage to Vegetation* (ed. J. A. Naegele: *Advances in Chemistry Series 122*).

Setting of an air quality standard involves making a compromise, balancing the costs of air pollution against its benefits. Our evaluation of costs and benefits changes as scientific knowledge of effects increases, new abatement technologies become available, and economic circumstances change. The recent increase in the price of low-sulfur fuels means that the benefits of air pollution have now increased. The point made in my article was that the costs of air pollution have sharply increased at the same time, as a result of a shortfall in agricultural production. I agree with Rossin that we need a careful study of the impact on the total system, but I believe that this would justify strengthening rather than weakening emission standards.

Neither Facts Nor Logic

I am insulted by the item entitled "Consumers Correct: Economics Wrong" (*"Trend of Affairs," January, p. 57*). Professor Galbraith's approach to economics seems to be publicity-seeking rather than analytical; and his statements, including the one in your article, disregard all of the facts of the situation and are not based on logic even if we accept the facts that he uses. It is obvious even to a casual observer of the economic situation that Professor Galbraith's statement regarding supply and demand in relation to gasoline completely ignores the fact that prices of gasoline have been regulated for some time now. For an economist to ignore this fact must be intentionally misleading; and for your publication to cover this statement is an insult, because I presume that all readers were either trained in or at least believe in the scientific method of reasoning.

Mark R. Ordower
Chicago, Ill.

"Swans" Corrected

The Escher print shown in the March/April *Technology Review* (p. 89) is a wood engraving (not a mezzotint) and was completed in February, 1956 (not 1951). It's a great print, nonetheless.

Cornelius Van S. Roosevelt
Washington, D.C.

Hydroelectric Power: A Non-Renewable Resource?

Technology/Environment
by
Ian C.T. Nisbet

The energy crisis of 1974 has left us with a choice between four unpleasant alternatives: to cut back our planned growth in consumption, expand our production and use of fossil fuels, relax the pollution standards that we felt were so necessary during the last four years, or make the irrevocable, Faustian commitment to a plutonium-based technology. Official U.S. policy is to do all four, which will probably ensure that we suffer the disadvantages of each.

However, there is a fifth possibility: to develop new, non-polluting renewable sources of power. Although it might seem more logical to develop solar power, the only influential group of engineers with a vested interest in "renewable" energy resources is that of the dam-builders. So a number of marginal hydroelectric projects which had previously been shelved for economic or environmental reasons have recently been resuscitated—ranging from the little Dickey-Lincoln project in Maine to continued proposals for big new dams on the Colorado and Snake Rivers.

In fact, the United States has little potential for significant hydroelectric development: most of the best sites are already exploited, and even damming the Grand Canyon would do little to relieve the nation's energy problem. But in the present climate of resource crisis and environmental concern, even small projects are attractive enough to put their opponents on the defensive. Elsewhere in the world, hydro schemes have much greater economic appeal, and vast projects are underway—if all the dams on the drawing board come to fruition, most of the major rivers of the world will be under control within 50 years.

To an engineer with the "beaver syndrome", an undammed river must represent simply a wasted resource, an inexhaustible supply of energy which can be harnessed and passed on downstream with only local disruption. Seasonal high flows must appear especially wasteful, for the fish and other creatures in the river evidently survive the season of low flow. Hence any additional flow is by inference unnecessary, if not downright damaging. By damming the river one should be able to even out the flow and provide continuous benefits for man and wildlife alike.

Most of the great dams of the world have been built primarily for a single purpose: either to generate electric power, or

for irrigation. As more and more evidence has accrued for environmental damage downstream, dams are increasingly being built for multiple purposes and a variety of downstream benefits is being claimed in mitigation. The most important of these are flood control and "low flow augmentation"—the latter a broad term which encompasses *maintaining* a water supply for navigation, for industry, for cooling power stations, and for diluting pollutants. However, environmentalists tend to dismiss such claims and point to evidence that many of the alleged benefits are in fact costs.

The downstream costs imposed by dams fall into several categories, of which one of the most important is economic and largely outside the scope of this article. "Providing flood control" is often little more than a euphemism for "encouraging building in flood plains". For some projects, such as that proposed a few years ago for the Connecticut River, this indeed appears to be the primary motivation. Economic development in flood plains then increases the capital at risk from an unusually severe or local flood, which justifies further flood control measures, and so on.

Hydrologists and geomorphologists counter by pointing out that flood plains are adjusted naturally to the recurrent flood levels of the drainage basin, so that complete protection from flooding is an unattainable goal. The cheapest method of flood control is to build on higher ground and let the flood plains flood. Another counter-argument, this by biologists, is that flood plains are highly productive natural systems with unique values which are absolutely dependent on periodic flooding.

Even if the average flow of the river is maintained unchanged, low flow augmentation, which averages out the fluctuations, has profound adverse effects on a river. Most aquatic organisms—plants, invertebrates, and fish—are adapted naturally to take advantage of seasonal fluctuations in flow rates, nutrient levels, and temperature, and do not function normally if they are reduced. This is not to say that these organisms use the river flow "efficiently", in the power engineer's sense; they have evolved to take advantage of the river's natural variability and in consequence depend on it. Periodic flooding is necessary to maintain the productivity and diversity of marshes and flood-plain ecosystems, including those used for agriculture. Most of

the natural changes in river channels and the turnover and transport of river sediments take place during the short periods of peak flows. If these dynamic features of a natural river system are impaired, its ability to absorb and degrade pollutants—one of the functions allegedly enhanced by low flow augmentation—may be reduced. Estuaries are particularly sensitive to flow equalization, because estuarine plants and animals are very dependent on fluctuations in salinity and their life cycles are often timed to take advantage of the spring freshets.

If the total flow in a river is reduced—for irrigation purposes, inter-basin transfers, or by evaporation from reservoirs—the consequences are usually more serious. The capacity to absorb heat and pollutant loads is reduced, sediment transport is further limited, and biological systems are more stressed. In extreme cases withdrawal of too much water may cause extensive intrusion of salt into the estuaries and lower reaches. A classic horror story is that of the Colorado River, which at times of low flow scarcely reaches the sea at all. Yet the water withdrawn from it is still insufficient to prevent salinization of irrigated land in the Imperial Valley; and the oil shale development program apparently envisages substantial further withdrawals of water from the upper basin.

Perhaps the most serious downstream consequence of dams is the loss of the natural sediment load brought from upstream. Even where flood-plains are still flooded, the natural input of silt and nutrients is cut off and farmers have to add artificial fertilizer to maintain the productivity of their irrigated land. A classic case is the delta of the Nile in Egypt, where dams built during the last 100 years have successively reduced the supply of silt that maintains the delta and the nutrients that support marine life. The shoreline has been eroding progressively for 100 years, to the point where the coastal agriculture is threatened by the intrusion of sea-water; the once-thriving marine fishery collapsed immediately after the completion of the Aswan High Dam. The great James Bay project in northern Quebec similarly threatens a uniquely productive sub-arctic bay.

The loss of the silt and nutrients from the flood-plain reminds us, of course, that they are trapped in the reservoirs behind the dams. Hydro-electric power is not, in
(Continued on p. 64)

The Dance of Legislation: A Case History

National Report
by
Victor Cohn

"The dance of legislation" has begun on national health insurance. The lilting phrase is Woodrow Wilson's, who wrote in his *Congressional Government*, "One begins the dance of legislation, and you must struggle through its mazes as best you can to the breathless end—if any end there be."

The phrase was borrowed last year by one Eric Redman to describe, brilliantly and amusingly, the progress of one federal health program through Congress. Mr. Redman, then a Senatorial aide aged 22, was its shepherd. His age in itself tells a good deal about the legislative process.

It is a process far removed from the picture in civic textbooks. It is a peculiar chaos.

Take national health insurance. The United States has enacted only a few bits of health care legislation—Medicare and Medicaid—and has failed to erect an adequate system to contain costs. These have now climbed so high that Republicans and Democrats, while generally agreeing on the need for a thoroughgoing health plan, recoil in fear from its price.

This spring even Sen. Edward M. Kennedy put aside his bill for a virtually total payment plan, and joined fiscally conservative Rep. Wilbur Mills to present a more limited one. In political fact, Senator Kennedy had already been deserted by most of the liberals whose support he needed. Also, President Nixon had put forth a reasonably attractive, if even more limited, proposal. Also, Senators Russell Long and Abraham Ribicoff were pushing a sexy "catastrophic illness" plan.

The outlook for Senator Kennedy's first and broader bill might change if a liberal Congress were to be elected in a wave of anti-Nixon, anti-Republican feeling next November. But the political reality this spring was that some kind of limited bill just might be passed, and Senator Kennedy had to act if he wanted his name on it.

Bill Passage: "Eliza Crossing the Ice"

What kind of health bill will be passed if one successfully moves through this Congress? Very likely not a Nixon bill or Long-Ribicoff bill or Kennedy-Mills bill, but some compromise. How are such compromises welded? Turn now to Mr. Redman's delicious yet often dismaying *Dance of Legislation*, (just reissued in a \$2.95 Touchstone paperback by Simon & Schuster).

Mr. Redman, today a Harvard law stu-

dent, began his political career in 1968 as a campaign worker for Washington Senator Warren G. Magnuson. He was then 20. That November he joined the Magnuson staff as the Senate's youngest legislative aide. He left before long to finish college but returned in early 1970.

An ardent Seattle pediatrician, Abraham Berman, had just convinced the quiet but powerful Senator Magnuson that a "National Health Service Corps" was needed to enlist young doctors to serve in the nation's under-doctored boondocks and ghettos. Such a corps would assign volunteer doctors to serve such areas for a period and pay them federal salaries. As Mr. Redman quickly realized, this would be socialized medicine, though it must not be called that.

In the phrase of Harvard Professor Richard Neustadt, every bill is "an Eliza crossing the ice." Of the more than 20,000 bills to be introduced in that 91st Congress, only a few hundred would become law. And the Health Corps idea was being launched at the very time that Mr. Nixon's first Assistant Secretary of Health, Education and Welfare (H.E.W.) for Health, the hapless Roger Egeberg, was openly charging that the men of the White House were "calloused," "indifferent," or "insensitive" to health problems.

Choosing the right legislative strategy was vital, then, if the Corps was to win enough bipartisan support to overcome a potential Presidential veto even if it did pass. Strategy after strategy was tried—not mainly by senators or representatives but by their staffs. Congress is not really run but it is certainly operated by the staffs of the more important legislators and key committees. A congressman is as strong as his staff, and vice versa.

The first Magnuson staff strategy was simply to have "Maggie" add a few million earmarked dollars to the \$20 billion H.E.W. appropriation bill, his charge as H.E.W. Appropriations Subcommittee chairman. But employing doctors by this means, it turned out, would be impractical and illegal.

Staffs and members of the Senate and House Health Subcommittees next agreed to add a Health Corps amendment to a routine Public Health Service amendments bill. Then, in May the U.S. troops invaded Cambodia, anti-war forces stormed the Capitol, and the Cooper-Church effort to bar future invasions became the only item of Senate business. By the time Mr.

Redman was able to get back to health, the Senate Health Subcommittee and full Labor and Public Welfare Committee had already voted out the P.H.S. amendments.

Could these be further amended on the floor? This is always hard, but it was the next ploy to be explored. By now, however, the White House was aware of this seemingly minor bill that actually would create a new way of medical care. H.E.W. health officials, including Dr. Egeberg, were ordered to cool their enthusiasm. H.E.W. underlings who had promised Mr. Redman and colleagues their expert help disappeared in the underbrush. Administration health emissaries made it clear that the idea was too unpalatable for a floor amendment.

On the evening of July 8, Mr. Redman writes, "we sat down in the deserted Senate Office Building and typed out the legislation we wanted. We had spent four frustrating months trying to extract a draft from the 'experts' at H.E.W. It took us precisely an hour to write it ourselves."

The dance of legislation thus continued inexpertly with a search for partners. The essential ones were Senator Ralph Yarborough (D-Texas), the soon-to-be lame duck but still-potent Chairman of the Senate Health Subcommittee; Representative Harley Staggers (D-W. Va.), the House Interstate and Foreign Commerce Chairman; and Representative Paul Rogers (D-Fla.), today the Chairman and then chairman-in-effect of the Staggers Health Subcommittee.

All ultimately joined the crusade, but in every case it was a process that required weeks of staff negotiation and horse-trading, an endless number of visits and pleas, the help of health lobbyists and carefully aroused groups, and personal representations by Senator Magnuson to his equally health-minded yet fiercely proud Capitol colleagues.

"A Pauline in Perpetual Peril"

Would Messrs. Yarborough, Staggers, and Rogers join the fight? Would they hold hearings in time? Could a conservative Kentucky Representative Tim Lee Carter (a physician and Health Subcommitteeman) be dissuaded from his conviction that this plan would socialize medicine?

The answers all turned out yes, but each was a cliffhanger. (Every bill, Professor Neustadt says, is also "a Pauline in perpetual peril.")

Senator Yarborough's Republican sub-

committeemen for a time boycotted every meeting he called. The Senate bill unexpectedly came up on the floor when Senator Magnuson was absent. In a frantic and hasty negotiation, Colorado's Senator Peter Dominick, top Republican on the Health Subcommittee and a conservative of gold-plated credentials, agreed to be floor manager. The bill passed by 66 to zero, though some members were under the impression that no money would ever be appropriated.

Only the war issue, and Congress' failure, accordingly, to pass essential appropriation bills, kept Congress in session long enough for House action.

Senator Magnuson, Senator Jennings Randolph, Chairman of the important Senate Public Works Committee, and Senator Dominick all lobbied the White House to successfully prevent a Presidential veto, though a veto message was sitting on the President's desk.

There is much more to the story, but the point is that this so-called minor yet potentially important legislation was passed with almost no examination or planning by truly qualified specialists in health care.

There is a Health Service Corps today. Three hundred and fifty "assignees" (243 MDS, 48 dentists and 60 other health workers) serve 183 communities at an annual budget of \$12 million. This is far from a large enough group to serve even the most accurately underdoctored areas. Yet, as Mr. Redman concludes, "A permanent change in American health policy has probably taken place: government-paid doctors are caring for the poor and the needy."

Can the same adversary relationships and almost haphazard legislating produce as decent a result on national health insurance? Can it sensibly produce a plan that must be infinitely more complex, with far greater potential impact on the country's doctor supply, medical costs, quality of medical care and personal health? I doubt it.

Many of the plans now sitting on legislators' desks are good ones, drawn with expert help. But many also have strongly political clauses, some of them present to be compromised away if need be. Similarly, the Administration's health plan is a hodge-podge of the expert and political, drawn in part to please the insurance industry giants.

Britain—quite differently—based its national health plan on the carefully constructed Beveridge reports. The first was issued in 1942 and the next in 1944. The National Health Service was enacted in 1946 and began operating in 1948.

In the meantime there was much planning, public discussion, compromise, and eventually agreement, rather than our dance of legislation that is indeed amusing, yet too often an impromptu frenzy rather than a well choreographed number.

Victor Cohn reports on major science-oriented affairs for the Washington Post.

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Imagining Failure, Successfully

Economics/Sociology/Technology
by
Kenneth E. Boulding

I had a pleasant weekend in Boston recently, among other things giving a Karl Taylor Compton Lecture at M.I.T., and, as usual when I am in Boston, I admired the progress of the disintegration of the John Hancock Building, the window panes of which, as is well known, have a distressing habit of falling out in a high wind. To those of us laymen who spend a good part of our lives being slightly awestruck and intimidated by the superior competence of engineers, there is a slightly evil gratification in the spectacle of engineers being caught out.

To one who has watched downtown Boston intermittently over 40 years being transformed from a charming city of human scale, if a little down at the heels, to a bleak wasteland of inhuman throughways, glass, steel, and cement, it is hard to refrain from a certain ironic satisfaction of having the latest monument of inhuman architecture turn into a soaring fantasy of flying glass. I recall the same slightly evil satisfaction when Tacoma Bridge fell down, thus proving again that engineers are human enough to make mistakes.

An economist, however, should not take a high moral line about glass houses, as we certainly live in one ourselves. The success of Keynesian economic policy, which in its own way is as substantial as that of the bridge builders and the skyscraper architects, also makes one a little nervous. We buy reasonably full employment with a little inflation and perhaps a little more inflation, and perhaps a little more, and who is to say where we will go over the edge?

The history of both bridges and skyscrapers is instructive in this regard. Engineers start off with big safety margins, and not too surprisingly the designs work. The bridges stay up, being three or four times stronger than is necessary, which is much better than being only .99 times as strong as they need to be. Redundancy, however, whether in strength or in anything else, is expensive. So a process of shaving goes on. Each successive bridge is a little lighter, a little cheaper, and they still stay up. Finally, we come to the Tacoma Bridge, which would have stayed up if it hadn't been for a strong wind and aerodynamics.

There is always something that we haven't thought of, and this is what causes the catastrophes. Bridge engineers (and I suspect also skyscraper architects) are

simply not trained in aerodynamics. When a bridge or a building begins to act like an aerofoil, things start flying that were not intended to. So we learn where the cliff is by falling over it, which I have always maintained is the bad way of learning about cliffs.

Learning by failure, of course, is the method of biological evolution. The genotypes that are around today are the survivors of a very large number of unsuccessful experiments. The unsuccessful mutations fell over their metaphorical cliffs and did not survive; the successful ones were those that did not carry their lines of development to the point of catastrophe. There are indeed evolutionary parallels to the Tacoma Bridge and the John Hancock Building, such as the dinosaurs, which apparently got larger and slower and scallier and more invulnerable until they all stuck in the mud and perished, whereas the scruffy little adaptable mammals who scuttled around underneath them survived.

Success Is Failure:

The Adaptable Survive

The moral of evolution is that nothing fails like success, because successful adaptation leads to a loss of adaptability. It is the meek, that is, the adaptable, not the adapted, that ultimately inherit the earth.

The extraordinary biological success of the human race, at least as judged by its population growth, is a result of its remarkable nervous system. The fact is that the human body is not very well adapted to any particular environment. But the enormous capacity of its brain for perceiving complex images of the world has given the human race fantastic adaptability. Our species can survive for brief periods with the aid of large-scale organization even on the South Pole and on the moon, where perhaps no other form of life can make it.

The ability of humans to imagine getting into trouble often helps to save them from really getting into trouble. It is when imagination fails, and we do not think of things that we ought to have, that our survival may become a real issue.

Science is the latest and perhaps the greatest exercise of the human imagination. It is a vast panorama of imaginary worlds, structured in the inconceivable complexities of the human nervous system, which guides its practitioners into usually non-catastrophic experiences of

testing at the interface between the imaginary world and the real world. Sometimes indeed the experiences are catastrophic—a test plane crashes, a laboratory blows up, a bridge or building collapses. These events, however, are relatively rare and on the whole the record is one of extraordinary success. This success, however, should make one hesitate; have we adapted so well that we no longer are adaptable? It is the things that we haven't thought of that lead to the hazards that we do not see.

This is why a purely technical education can be disastrous. It trains people only in thinking of things that have been thought of, and this will eventually lead to disaster. It is the engineers, I think, who invented Murphy's law—that if anything can go wrong, it will. Who indeed but an engineer could have formulated a principle so pregnant! Murphy's law, however, can be stated in a quite unexceptional form—that if anything can go wrong, it *eventually* will. The smallest probability for disaster will come off if we wait long enough; the thousand-year flood, the 10-point earthquake, the nuclear holocaust, the ultimate plague. Long-run survival always depends on the capacity to survive improbable disasters.

In this light, the very success of science and technology makes one nervous. Is there something that we haven't thought of? If so, how do we think of it?

Kenneth E. Boulding, former President of the American Economic Association, is Professor of Economics at the University of Colorado and Director of the Program on General, Social, and Economic Dynamics at the University's Institute of Behavioral Science.

May 11, 1974
U.S. ENERGY PLAN
FOUND TOO COSTLY

**M.I.T. Study Recommends
Stockpiling Rather Than
Total Self-Sufficiency**

By **VICTOR K. McELHENY**
If the United States tries
meet all its energy needs
domestic sources, new
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PHILADELPHIA DAILY
NEWS
PHILADELPHIA, PA.
D 262,398

Y 14 1974

Price Jump Seen in 'All-U.S.' Oil

energy by 1980, the Massachusetts Technology. Scientists laboratory school's

Mass. (UPI) will during the Arab oil embargo if the U.S. goes ahead with plans to become self-sufficient in

NEWSPAPER
PHILADELPHIA, PA.
D 262,334
MAY 14 1974

United States tries to get all its energy from domestic sources, the goal of the nation's

Since L.HENY

1980

MA

CAMBRIDGE, Mass. (UPI)
—Oil and gasoline prices will
soar even higher than they did

seen in
during the Arab oil embargo if
the U. S. goes ahead with plans
to become self-sufficient in
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Scientists
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MAY 14 1974

Self-Sufficiency Attempt
Will Push Fuel Costs Up

United Press International
CAMBRIDGE, MA
and gasoline

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U.S. halts
troops

London Evening Globe

May 10, 1974

**Energy self-sufficiency by 1980 means
more price hikes, MIT study says**

y Robert Cooke
Jobe Staff

American effort
efficient in ener
1980 will requ
boosts as great
past winter, a
chusetts Ins'
study release

CHICAGO DAILY NEWS
MAY 10, 1974

10, 1974

NEWS

Energy self-sufficiency
to be costly, study says

Harlan Draeger

Americans will pay much more for energy prices if the nation succeeds in becoming independent of foreign oil, according to a major oil, accounting and engineering study released Friday.

The report, drafted by the American Petroleum Institute, is aimed at ending U.S. reliance on foreign fuels by 1980.

ECONOMIST Paul W. Miller, one of 10 members of the study, said the Arab oil embargo, which followed the Arab oil embargo, will cost the U.S. \$10 billion a year by 1980.

By Harlan Draeger
America

The report, drafted by a team from Massachusetts Institute of Technology (MIT), strongly suggests that U.S. "self-sufficiency will be phased at a very gradual rate and is not a realistic goal."

aimed at ending U.S. reliance
on foreign fuels by 1980.

ECONOMIST Paul W.

Economist Paul W. Mac-
Aroy, one of 10 major authors
of the study, reviewed the find-
ings at an MIT-sponsored con-
ference on "Managing Man-
and Scarce".

The Arab oil embargo that followed the Mideast war stirred a strong push to develop synthetic oil, syn' gas and oil shale. However,

However, ..
aid ene-

SUN-TIMES
CHICAGO, ILL
MAY 11, 1974

Findings of the report down a formidable ecological challenge to "Project Independence," a national policy announced by President Nixon Nov. 7. The program

By Philip Moeller

By Philip Moench
Complete energy independence is not worth the high price, an in-depth study by the Energy Laboratory at the Massachusetts Institute of Technology (MIT) has found.

cause it's basically a national gas shortage. You're going to have a first."

By the late 1970s, there might be no gas available for industrial use, MacAvoy said, with supplies for commercial users possibly running out a few years later.

Total energy independence would require fuel price increases as large as those announced last fall.

mercial development of synthetic fuels in the near future," it adds. The prospect for developing large supplies of synthetics is not "sufficiently promising," it says, to justify higher prices for all types of energy.

Developing half a million barrels a day of synthetic fuel capacity (less than 2 per cent of our needs) would require twice the amount of construction as the present nuclear program.

"The federal government ought to offer to purchase oil, methanol or gas from synthetic commercial plants at a price agreed upon by negotiation or resulting from competitive bids," the MIT researchers say.

While such developments in domestic fuels are taking place, security from import "disruption" could be provided by the relatively expensive creation of a

Storing enough oil to last a year-long cu

industry," the summary says. "the cost of oil delivered to consumers would rise by no more than 26 cents per barrel or one-third of a cent per gal-

"We're the only Western country that does not have a security inventory," MacAvoy said. The report also advocates phasing out price controls on natural gas and petroleum.

The authors of the report, MIT scientists and economists, stressed that attempts to analyze the energy situation are significantly limited by an array of unknown factors. Conclusions are

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May issue with MIT's
report on energy self-
sufficiency available.
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The tide is turning: America's large cities are on "the threshold of new growth and revitalization"—a change, write the authors, which promises "a new phase in the nation's pattern of urban growth"



After two decades of decline, the population of Boston is now rising at about 2 per cent a year (since 1970). All the economic indicators—jobs, pay, capital investment—are up. Though Commonwealth Avenue (above) never lost its dignity, there has been a redoubled effort to improve the city's public facilities and amenities. (Photo: Boston Redevelopment Authority)

Alexander Ganz
Director of Research
Boston Redevelopment
Authority

Thomas O'Brien
Director, Office of Planning
and Management
Commonwealth of
Massachusetts

New Directions for our Cities in the Seventies

A *Philadelphia Inquirer* reporter interviews Boston Back Bay residents to find out why they have moved back to the city. A *Los Angeles Times* story heralds the return of the middle class to the central city. A *Fortune* magazine writer reports that "in the downtown of our big cities, things are coming together. . . . A small but significant portion of downtown office workers are forsaking the suburban dream and making their abodes at the core." The U.S. Census Bureau projects a concentration of 1970s population in the 25-to-34-year-old-age group—those whose lifestyles favor city living.

Our large cities are on the threshold of new growth and revitalization. This prospect represents a new stage in their evolution. Newly emerging factors of strength are reversing the tide which ran against job opportunities and the attractiveness of living in our large cities. Though problems are many, important new forces are underway, creating a new phase in the nation's pattern of urban growth.

This article presents new information and analyses on the evolution of our large cities, and a scenario of their likely development in the 1970s. These new directions are a cause for optimism for the vitality and viability of the cities, but they must also be viewed as a source of concern to the poor, since these changes may price much of their current urban housing beyond their reach. Those who are able to remain in the city, as well as those new to the city, are likely to experience an improved environment. However, the challenge of achieving the national goal of decent, safe, and sanitary housing for all is not likely to be met without new efforts to enhance the purchasing power of the poor.

The Boston Experience

Illustrative of the change in large central cities is the case of Boston, which has gone from full decline in the 1950s to economic revitalization in the 1960s and revival as a place to live in the 1970s.

Following World War II, through the 1950s and early 1960s, Boston suffered a process of decline. There was a large loss of middle-class families to the expanding suburbs. There was an outflow of manufacturing to suburban sites with modern one-story plant layouts and access to the interstate highway system. There was the suburban shift of wholesale and retail trade, taking advantage, respectively, of better transportation and market access. There was a fall in taxable property values. There was a relative neglect of public facilities. There was a sizable in-migration of the poor from areas of

lesser opportunity.

The Boston experience since the mid-1960s, however, has shown that fundamental economic forces now favor the economic growth of central cities.

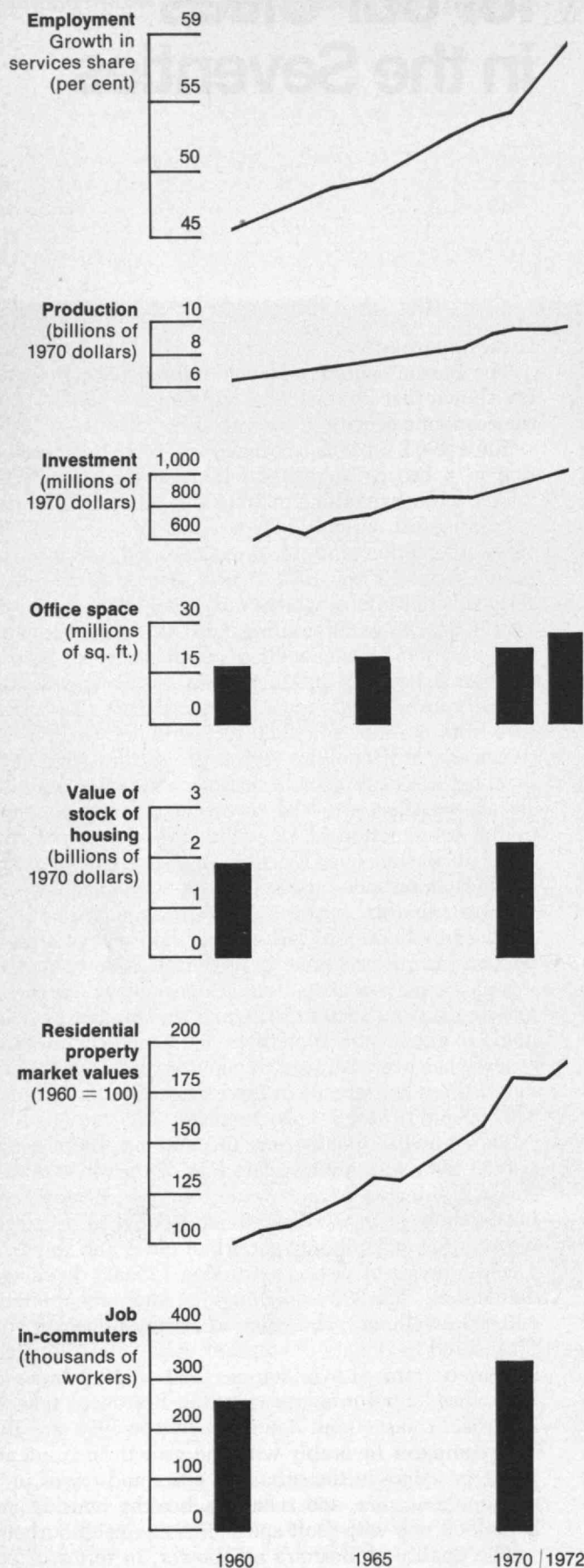
Since 1963, Boston has benefited from its specialization in a broad range of high-grade service activities which were expanding nationally—finance and insurance, medical service, higher education, business services, recreation and tourism, personal services, and public service. From 1963 to 1972, Boston gained 80,000 service activity jobs, which more than offset the further loss of 24,000 manufacturing jobs. With the growth in jobs, and the higher levels of productivity which they represent, Boston's production of goods and services (expressed in dollars of constant value, at 1970 prices) rose from \$7 billion in 1960 to \$10 billion in 1972. National and Metropolitan region projections suggest the prospect of future growth in Boston's service activities. Taken together with the private sector's commitment to the construction of 12 million square feet of office space in Boston over the next five to eight years, this signifies an outlook for 80,000 more service activity jobs for Boston in this decade. (See chart on page 12.)

The growth in jobs has already had a favorable impact on income and poverty in Boston. Mean household income, expressed in dollars of constant value, rose by one-fourth from 1960 to 1970, and the number of households living in poverty (those with incomes of \$4,000 or less) has been reduced by one-fourth. More than one out of three households in Boston now has an income of \$10,000 and over. (See chart on page 12.)

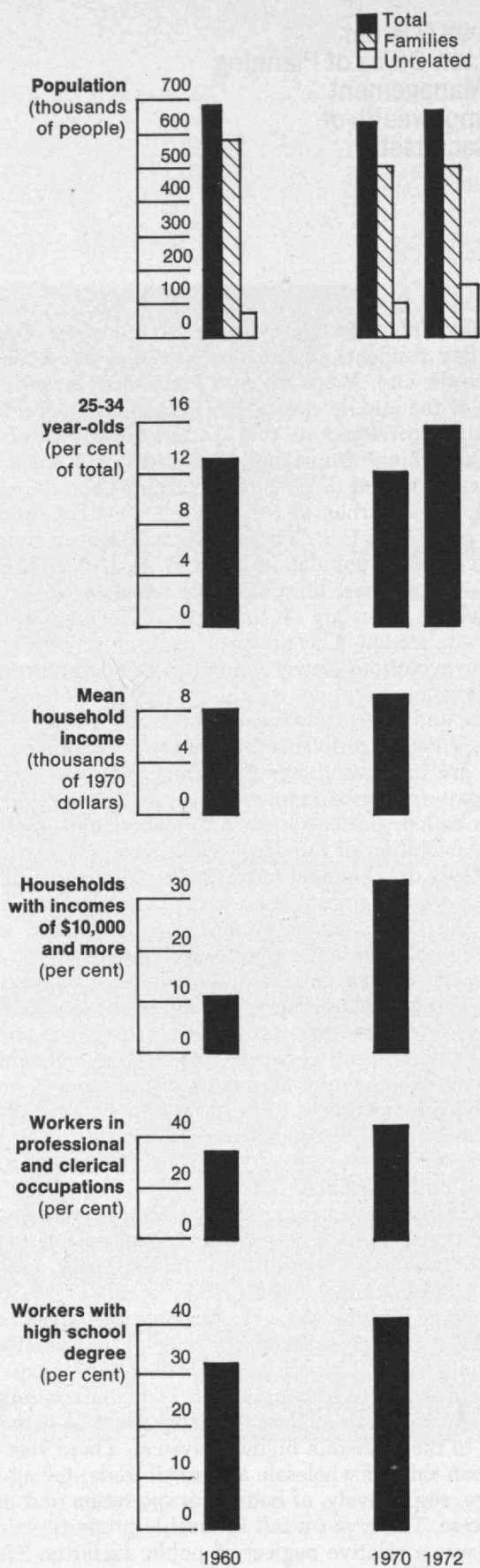
The growth in jobs and income has been accompanied by a substantial upgrading of the city's housing stock. Residential property values in most Boston neighborhoods have been rising at rates equal to or exceeding those in surrounding suburban cities and towns. As a consequence of new construction (25,000 dwellings), demolition (22,000 dwellings), and rehabilitation (10,000 dwellings), the value of Boston's housing stock (measured in dollars of constant value, at 1970 prices) increased from \$1.8 billion in 1960 to \$2.6 billion in 1970. Residential property values in Boston, as reflected in market transactions, doubled between 1960 and 1972. This compares favorably with the growth in residential property values in the suburban cities and towns in the metropolitan area, and reflects a healthy housing market, albeit one with "soft spots" in some neighborhoods.

The quality of Boston's manpower, in terms of educational attainment and occupational skills, improved

The Economy



The People



The revitalization of Boston as a place to live and work is shown by these data from the Research Department of the Boston Redevelopment Authority. Economic indications are shown at the left; they include a massive shift toward a services-oriented economy and an increase in productivity. Changes in the population of Boston are shown at the right; they include an increase in the city's population of 25-to 34-year-olds.

significantly in the last decade, benefitting from the combination of special manpower and education programs and the expanding number of better jobs. The share of Boston's labor force with a high school degree rose by 40 per cent, and the proportion with a college degree increased by 60 per cent, between 1960 and 1970. Correspondingly, the share of Boston's labor force in professional and clerical occupations grew by 22 per cent, while those in operative and laborer occupations fell by 19 per cent, in the 1960-70 period.

Labor market conditions in Boston also improved, with an important narrowing of the gap between the rate of unemployment in Boston and that in the metropolitan area in the course of the decade.

As a consequence of the strengthening of Boston's job market, the flow of job in-commuters increased by one-third between 1960 and 1970.

Laying the base for the growth in jobs and income, the upgrading of the labor force, and the improvement in the housing stock was a notable rise in capital investment in Boston. Capital construction and equipment outlays (measured in dollars of constant value, at 1970 prices) expanded from an annual average rate of \$650 million in the years 1961-67 to one of \$850 million in the 1968-71 period, and achieved an estimated \$1 billion rate in 1972. These increases were made up of growing rates of capital investment in office buildings and commercial structures, medical facilities and educational institutions, new and rehabilitated housing, and public facilities and capital improvements.

Especially noteworthy was the redoubled effort toward the revitalization of the city's antiquated and obsolescent public facilities. Capital expenditures by the City of Boston on public facilities and capital outlays rose from an average annual outlay of \$20 million in the years 1950-67 to \$50 million in the 1968-71 years, and to \$90 million in 1972 (The figures are in constant dollars at 1970 prices).

A recently completed survey of capital construction in progress in Boston indicates that a further rise in capital investment is in store, at an annual rate of \$1.50 billion over the next three to five years. Most significant of all are the implications of this investment for the kind of city Boston is becoming. The service activity role of the Boston economy will be reinforced. A rebirth of the city as a place to live is underway. There is a new process of concentrated growth, in the core area of the city, of jobs and income, population and housing, and retail trade activity.

The Boston Police Department 1972 Census shows that Boston's population is now rising, after two decades of decline. When compared to the 1970 U.S. Census, the Police of 1972 indicates a population growth of 18,566 persons 20 years of age and over—an increase of four per cent. This two per cent annual rate of growth compares with annual rates of decline of -1.4 per cent in the years 1950-60, and -0.8 per cent in 1960-70.

Population growth was concentrated principally in the 25-34 age group, which rose by 19,633 persons from 1970 to 1972. There was also growth in the 20-24 age group, and those 65 and over. Conversely, there was a continued, though slackened, decline in the 35-64 age group, which had borne the major share of population loss in the 1960-70 decade, reflecting the outflow of families.

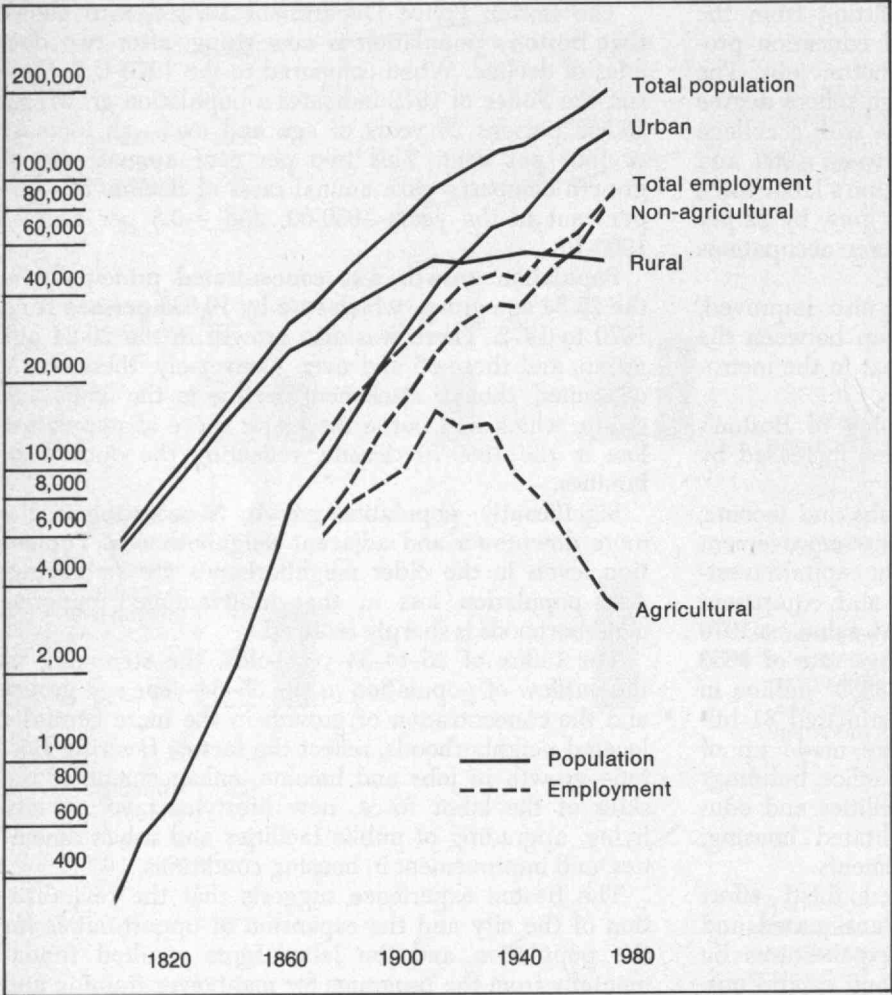
Significantly, population growth is occurring in the more downtown and adjacent neighborhoods. Population levels in the older neighborhoods are stabilizing. And population loss in the disadvantaged minority neighborhoods is sharply reduced.

The influx of 25-to-34-year-olds, the stemming of the outflow of population in the 35-64-year age group, and the concentration of growth in the more centrally located neighborhoods, reflect the factors favoring Boston—growth in jobs and income, enhancement of the skills of the labor force, new lifestyles favoring city living, upgrading of public facilities and urban amenities, and improvement in housing conditions.

The Boston experience suggests that the revitalization of the city and the expansion of opportunities for the population and the labor force resulted fundamentally from the programs for manpower training and social services, housing and urban renewal, and the revival of public facilities and capital improvements. It was a combination of the services revolution, with its impact on jobs and income, and ambitious public programs and private investment commitment that turned the tide.

Despite a number of features unique to Boston—including the key role of public policy in revitalizing the city's public facilities beginning in 1968, and the city's specialization in a broad array of service activities that are expanding nationally—Boston's experience is the outcome of a long-term evolution that included urbanization, suburbanization, and, finally, the revitalization of our large cities as places to work and live, heralding a renaissance in the 1970s.

From farm to city—and then to suburbs: in eight words the story of American urbanization since 1800. Now, write the authors, Americans 25 to 34 years old “show a strong preference for city living,” and there is beginning “a fundamental change in the livability of our cities”



The process of urbanization throughout American history is shown by Census Bureau data on population and employment. As agricultural productivity increased, agricultural employment declined and people moved to the cities.

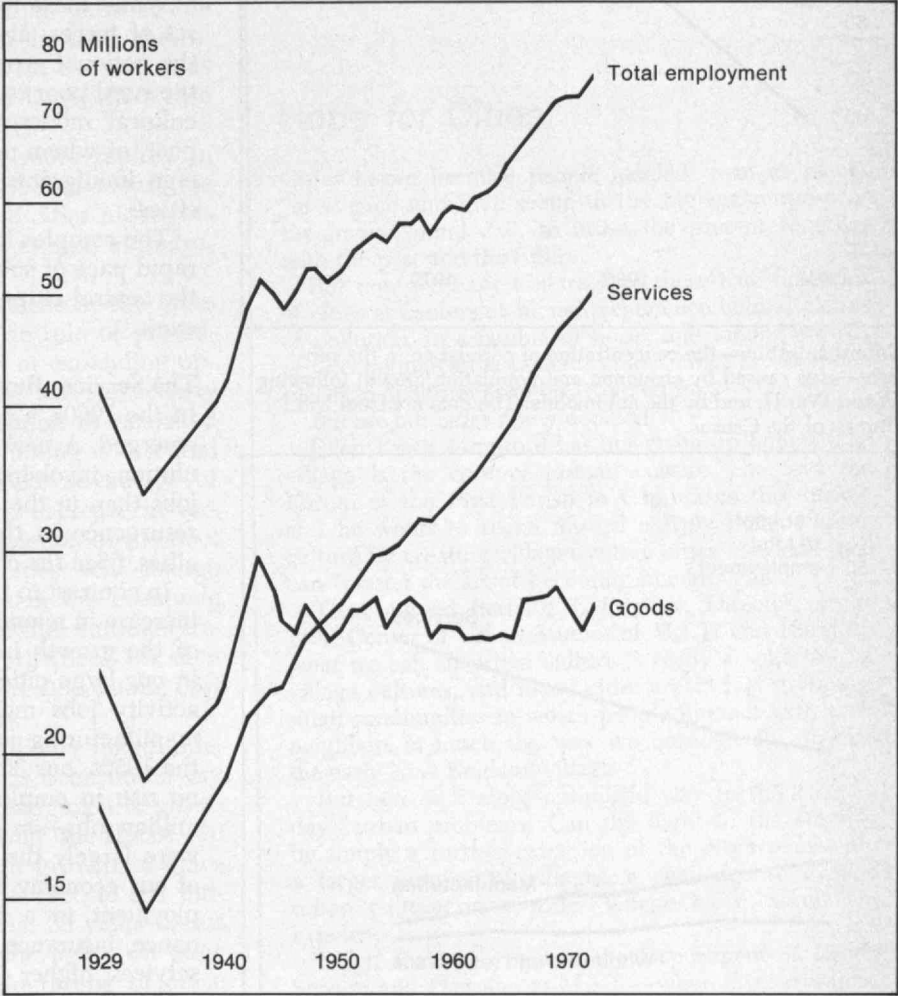
Urbanization

The process of urbanization in the United States reflected the pattern of economic change. In the 17th, 18th, and much of the 19th centuries, the quest for food was a primary determinant of the geographic distribution of population. Then the industrial revolution, with its improved transportation and its labor force requirements, spurred the growth of cities. Rising income levels led to an expanding demand for a broader and more sophisticated array of manufactured goods. Meanwhile, continuous gains in agricultural productivity made possible an expanding volume of agricultural produce with fewer workers. Those no longer needed in the production of food flowed to the cities.

The rise in income, the needs of industrial activity, and expanding agricultural productivity have brought about major shifts in population location and the skill level of the labor force. In the past 170 years, the share of our population living in urban places has risen from six per cent in 1800 to 66 per cent in 1970.

In 1869, 48 per cent of the nation's jobs were in agriculture. As our nation grew, the number of jobs in agriculture expanded, reaching a peak in 1910, when 11 million agricultural workers made up 30 per cent of the national total. By the eve of World War II, this share had been reduced to 20 per cent, and in 1972 3.5 million agricultural workers accounted for 4.2 per cent of the national job total.

The services revolution: the continuing change of the American economy from production of goods to provision of services. The data are from *The Economic Report of the President*, 1973.



In the last three decades, our rural areas lost population, while the cities and towns of our metropolitan areas absorbed these flows, as well as all of the population growth due to a large post-war baby boom. Over this period, the population of our metropolitan areas doubled, rising from 70 million in 1940 to 140 million in 1970. (See the chart on page 14.)

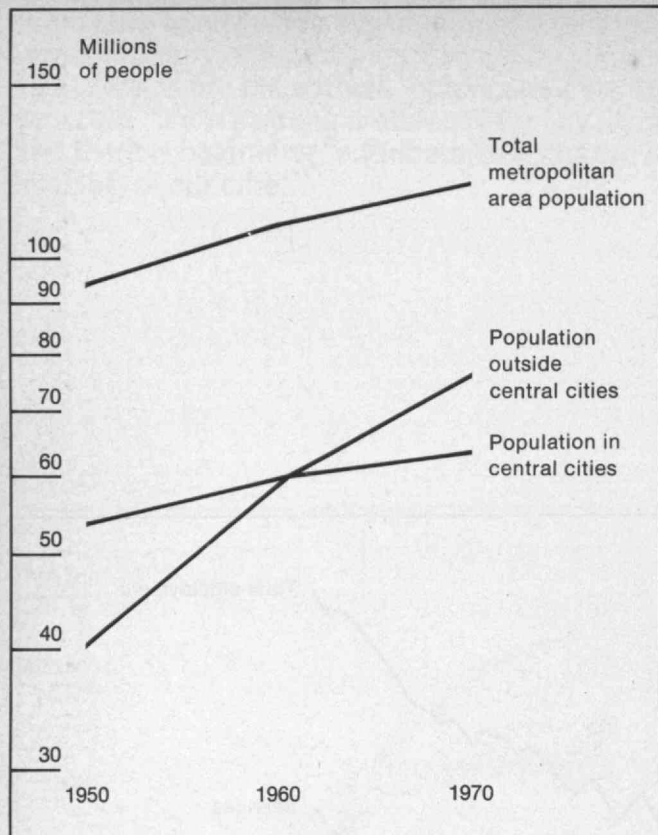
Suburbanization

Following World War II, a new phase in the role of our cities began as an accelerated process of suburbanization unfolded. In 1940, metropolitan areas (urbanized areas having a city with at least 50,000 people) were dominated by central cities which accounted for two-

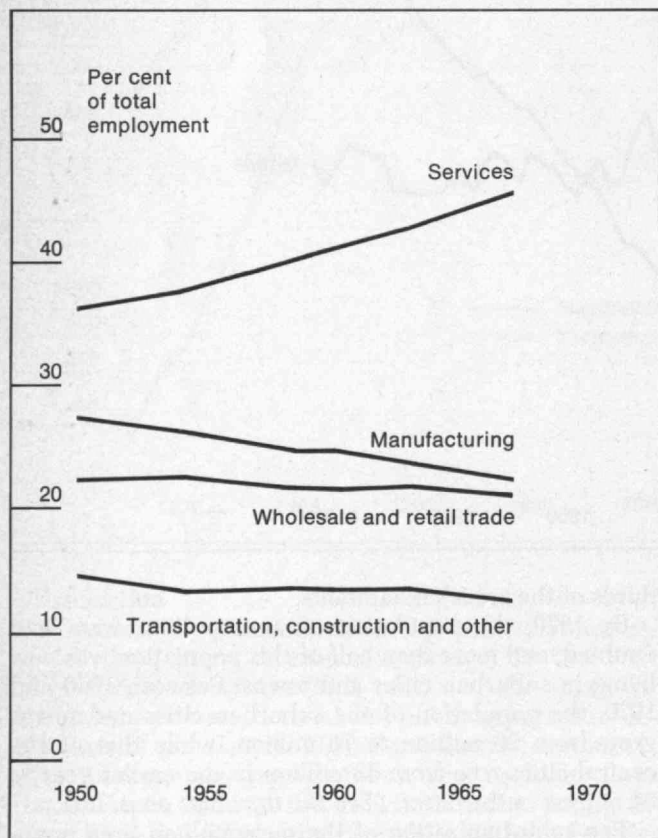
thirds of the areas's inhabitants.

By 1970, the population of metropolitan areas had doubled, and more than half of this population was now living in suburban cities and towns. Between 1940 and 1970, the population of the suburban cities and towns grew from 26 million to 76 million, while that of the central cities rose from 43 million in the earlier year to 64 million in the latter. (See the top chart on p. 16.)

The suburbanization of the metropolitan area population was followed by a suburbanization of jobs. Since 1960, employment in the suburban cities and towns of 30 large metropolitan areas has risen by more than 50 per cent, accounting for three-fourths of the total growth in jobs in those 30 metropolitan areas.



Suburbanization—the concentration of population in the suburbs—was caused by economic and population growth following World War II, and by the automobile. The data are from U.S. Bureau of the Census.



The services revolution as it affects our cities, which are the logical places for financial, communications, educational, and other services. The data are from the author's study, *Our Large Cities: New Light on their Recent Transformation*, M.I.T. Laboratory for Environmental Studies, January, 1972.

A number of forces contributed to the process of suburbanization. Postwar growth in the national economy brought new increases in family income levels and an expanding demand for new housing, with a preference for suburban location, which offered more internal and external space and improved amenities. The postwar baby boom meant younger and larger families, with better incomes, generating new pressures for housing and public services. Federal mortgage insurance and tax benefits made suburban home ownership easier and more attractive. A great expansion in car ownership emerged following World War II, as income levels rose. Responding to this, the Interstate Highway Program, initiated in the mid-1950s, made possible a far greater choice of where to live, and a fundamental change in goods movement and the economics of manufacturing plant location.

While these forces fostered suburbanization, another set of forces, also impelled by the postwar growth in the national economy, engendered a vast migration of the rural poor to the northern cities. Displaced by agricultural modernization and mechanization, the rural poor, of whom many were black, took the place of foreign immigrants as the new source of entrants to the cities.

The complex interrelationship of these forces led to a rapid pace of suburbanization, and a relative decline of the central cities, both as a place to live and a place to work.

The Services Revolution

In the 1960s, a countervailing force to suburbanization emerged. A new national phenomena, the services revolution, involving a greater growth in services activity jobs than in the production of goods, brought about a resurgence in the economic life of our large central cities. (See the chart on p. 15.)

In contrast to the suburban orientation of the postwar increase in manufacturing and trade jobs, a major share of the growth in services activity jobs is taking place in our large cities. In the 1960s, the growth of service activity jobs more than offset the continued loss of manufacturing jobs in our central cities. Whereas, in the 1950s, our 30 largest central cities had experienced no rise in employment, in the 1960s they gained 1.5 million jobs—an increase of 15 per cent. These new jobs were largely the result of a fundamental restructuring of our economy toward increasing production and employment in a broad range of service activities—finance, insurance, real estate, communications, medical services, higher education, business services, recreation and tourism, and government services. (See the figure at the left.)

As a consequence, in the 1960s the production of goods and services of these 30 large central cities rose by more than one-third (measured in dollars of constant value), and made up one-third of the nation's output by the end of the decade.

As a location of production, these cities continue to be enormously important, vital, and leaders in the transformation of an economy which produces more in services than in goods. Our 30 large cities accounted for half of the total growth of production in their metropolitan areas in the 1960s. (See the chart on p. 18.)

The transformation of our large cities was accompanied not only by an increase in jobs, but also an

upgrading in their productivity. With job gains in the 1960s representing one-fourth of that in their metropolitan areas, and 15 per cent of that for the nation as a whole, output per worker in the 30 large cities rose as rapidly, and maintained a higher level.

Even though jobs were expanding more rapidly in the suburban portions of our metropolitan areas, the resurgence of job growth in the central cities highlights their economic importance and their key role in metropolitan area growth and development.

The changing character of employment in the cities added complexity to the cities' historic role of providing the poor with an economic ladder of expanding opportunities. Unlike industrial activity, service activity jobs do not facilitate the easy absorption of unskilled manpower. Appropriate manpower training is essential to enable the poor in the cities to take advantage of the new opportunities. But the sharp decrease in foreign immigration, and the relative depletion of the pool of rural poor who migrated to the cities, will change the historic role played by the cities in the economic upgrading of new arrivals. Though the numbers requiring special aid will not be rising, the need for such aid will be greater because of the increased public cost of training people for white-collar jobs.

An office building boom of extraordinary magnitude, created by the services revolution, has been underway since the early 1960s, dramatically changing the physical profile of our large cities. During the 1960s, 20 large cities experienced a 40 per cent growth in office space, from 477 million square feet in 1960 to 681 million square feet in 1970, after a virtual 30 years hiatus in downtown office building. (*See the figure on page 19.*) There was also a substantial upgrading of office space standards, with office space per worker increasing by 25 per cent. Office building construction is remaking the downtowns of our large cities, and these new offices carry with them a demand for public services quite different from that of more dispersed industrial activity.

Office employment is giving rise to downtown residential development and an increase in downtown population. With jobs and people concentrated in downtown areas, improvement in central city transportation is essential. Two new developments in 1973 will favor central city development. The Highway Act of 1973 will provide a large new flow of funds for public transit systems, and new regulations proposed by the Environmental Protection Agency to meet clean air

Hope for Cities

Cities began because people needed them as places "to engage and give scope to the highest purpose of the human mind . . . to bring the present together with the past and the future."

But now we have lost track of these true functions of cities as centers of human experience behind clouds of pollution, in a babble of noise, and among crowds of uncommunicative humanity; and cities are as much places to flee from as to be attracted to.

But are our cities really doomed?

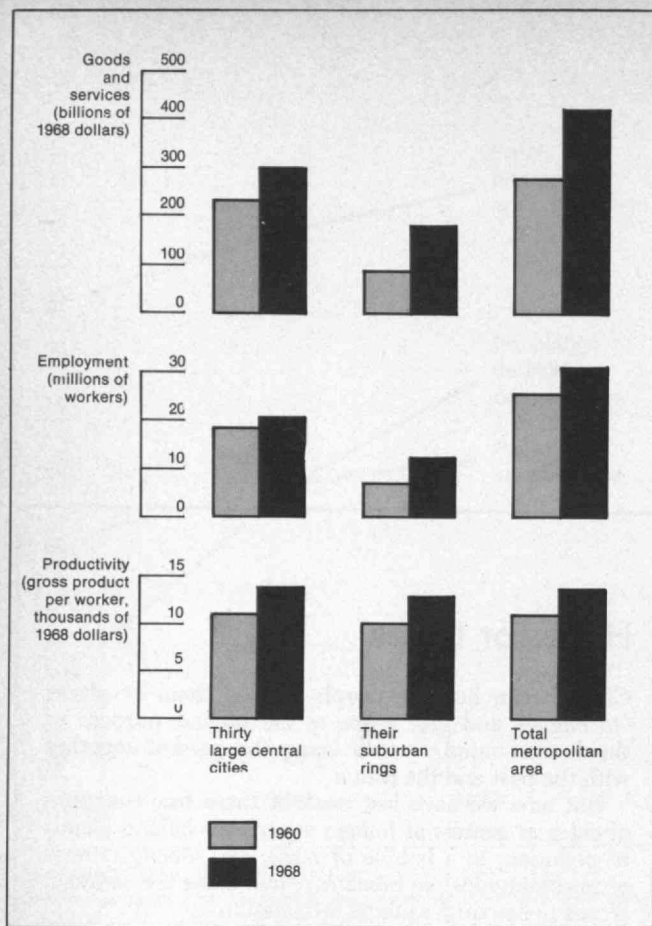
Even Lewis Mumford has not given up hope: "The village is the core of human culture," he told the Forum of the First Parish in Cambridge this spring, and he wants to reach toward a truly human urban culture by creating villages within cities in which men can "master the art of becoming human again."

True, agreed Bernard J. Frieden, Director of the Joint Center of Urban Studies of M.I.T. and Harvard; what we call an urban culture is really a collection of village cultures, and many cities are in fact groups of small communities in which people interact with their neighbors in much the way we nostalgically idealize the early New England village.

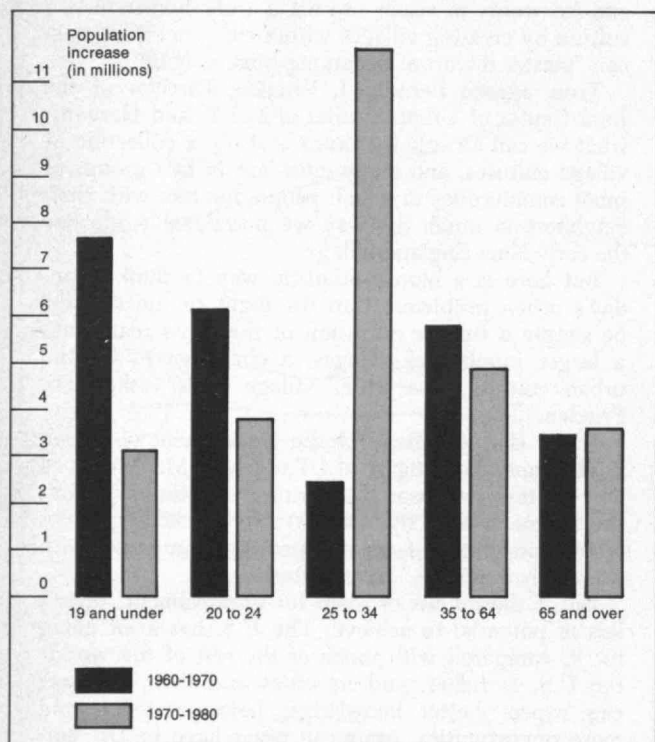
But here is a more optimistic way to think of today's urban problems: Can the flight to the suburbs be simply a further extension of the city's reach into a larger number of villages, a challenge to expand urban culture on a wider village basis? asked Dr. Frieden.

Lloyd Rodwin, Head of the Department of Urban Studies and Planning at M.I.T.—where Mr. Mumford was Visiting Professor this spring—is optimistic about the future of the city, too. "We've mucked up a lot when you think of what cities are compared with what they might be," he admitted.

But if there's lots of room for improvement, there's lots of potential to achieve. The U.S. has a lot going for it, compared with much of the rest of the world: the U.S. is richer, and its cities and their residents can expect better knowledge, better services, and more opportunities. American cities have better "survival capacities," Professor Rodwin said, and our potential for doing better should inspire us to fulfill it.



The growth in production, employment, and productivity in our 30 largest metropolitan areas through the 60s. Over half of the growth in production took place in the central cities.



The U.S. population is moving from concentration in the 19-or-under age group in the 1960s toward concentration in the 25-to-34-year-old age group in the 1970s—a group whose life-style seems to frequently include a preference for city living. Data from the Census Bureau; figures for the 1970s are projections.

standards in the late 1970s will restrict automobile use in our large metropolitan regions.

Scenario for the 1970s

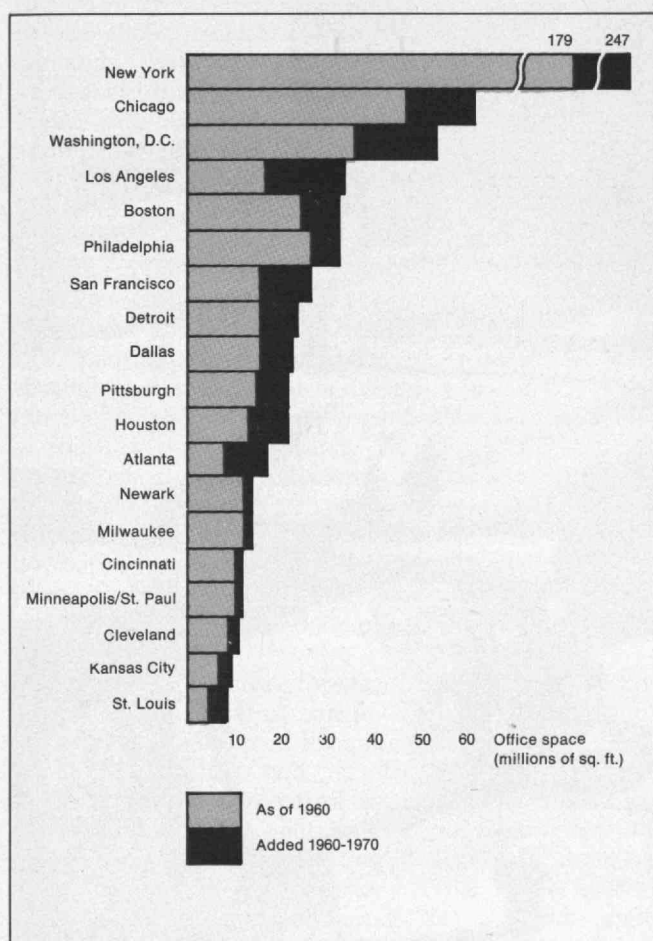
Newly emerging demographic patterns show a shift in the concentration of population from those under 19 in the 1960s to the 25-to-34-year-olds in the 1970s. The era when growth in the under-19 age group dominated population trends in the United States is behind us. (See the lower chart on this page.) In the 1970s growth in the 25-to-34 age group will be much greater than the anticipated change in all other age groups. In essence, the baby boom which encouraged suburban growth in the postwar period is being succeeded by a large growth in the 25-to-34 year old population, whose life styles show a strong preference for city living.

A lower proportion of teenagers will also mean reduced crime rates. And the slowing of urban migration will reduce the inflow of the poor. A new middle class may be expected to emerge in our large cities. Unfortunately, political perception of the needs of the poor is likely to weaken.

The scenario of the 1970s for our large cities appears to be one in which reinforced growth of jobs and income in services-activity oriented economies may be accompanied by a reversal of the pattern of population loss. In this scenario, the expanding role of public and private investment in infra-structure must be complemented by social programs enhancing housing upgrading, manpower training, and other services designed to encourage the advance of the cities as both places to work and places to live, if their social and economic potential are to be realized.

In this new chapter in the evolution of our cities, expanding service activities more than replace the loss in manufacturing, and the cities become increasingly attractive to those in higher grade occupations, as jobs expand. There will be larger public and private sector efforts to improve urban amenities and community facilities through public capital outlays and private investment in the construction of new housing and rehabilitation of the old. Poverty in the cities will be further reduced by the growth in jobs, and advance in education, and there will be a fall-off in in-migration of the less privileged from the South and from Puerto Rico as economic conditions in these areas continue their recent (1960-73) rate of improvement and provide an alternative avenue of opportunity. Aging structures will be replaced. The ratio of jobs to population will continue to increase. The housing stock will shift to higher levels of unit value. Growth in economic vitality will be complemented by population vitality as the number of 25-to-34-year-olds expands. Our large cities, with viable economies, will solve their fiscal needs through sympathetic new measures of the Federal Government and from an expanding flow of resources from the states toward the financing of public transit, education, and community development.

Both environmental concerns and the urgency for more efficient use of energy will favor the economic and residential future of the city. Automobile use will be restricted to meet stringent clean air standards and to achieve reduced consumption of oil. Central-city oriented public transit will be encouraged by the clean air standards, by the increased cost of energy, and by the Highway Act of 1973, which provides a new source



The enormous growth in office space in America's largest cities, spurred by the services revolution. The data are from *The Office Industry*, Regina Armstrong, Region Plan Association of New York, 1972.

for transit funding.

By the late 1970s it is most likely that public transportation will be greatly expanded and improved, that city air will be cleaner, that the journey to work will include public transportation for the rich as well as the not-so-rich, and that the attractiveness of suburban living, so dependent on the automobile, will decline.

Increased density of employment, a characteristic of the services revolution, will be favored to conserve energy, and better public transportation will be encouraged. Businesses will find significant advantage in locating close to public transportation and will call increasingly for its improvement. Just as highway location played a major role in determining the location of economic activity and the value of land, public transit improvement and expansion, particularly in the case of fixed-rail transit, will have an important effect on where people work and live, and this will have an impact on land use and land values.

City environments will be enhanced by future environmental and zoning standards limiting high rise clustering, requiring public amenities, protecting open space and architectural heritage, and fostering quality in residential building.

We firmly believe that a fundamental change in the livability of our cities is occurring. Now is the time to address the question of who will benefit by this change. To the extent that the poor can be provided with job skills to participate in the economic growth of the cities, and to the extent that their housing costs can be kept in line with their income, everyone will benefit. Unfortunately, public policy appears headed in the opposite direction. Livability for cities is most likely to translate into dispersion and invisibility for the poor. Channeling the coming changes so that they will be of benefit to the poor, as well as the middle and upper classes, is the challenge for public policy.

Since 1970, Alexander Ganz has been Director of Research of the Boston Redevelopment Authority. During the preceding decade, he was associated with M.I.T., as a lecturer in the Department of Urban Studies and Planning, a Research Associate in the Laboratory for Environmental Studies. In the 1950s and early 60s, his work concerned the development of the Americas. From 1952 to 1958 he was Deputy Chief of the Economic Development Division, United Nations Economic Commission for Latin America. In the 50s, he was a consultant to the Central Bank of Venezuela, the Federal Investment Council of Argentina.

For systems analysis methods to be successful when applied to resource allocation problems of urban public safety systems, they must be applied with an awareness of the broader organizational, political, and sociological factors that relate to public safety agencies and the citizens they serve.



The police dispatcher in Quincy, Mass., fills out an incident ticket following each dispatch of a patrol car. The new dispatch

strategies are being formulated with the assistance of computer-based models at M.I.T. (Photos by Sue Young)

Resource Planning for Urban Public Safety Systems

The demand for urban public safety services—police, fire, and emergency medical help—rose at unprecedented rates (in some cities 10 to 15 percent annually) in the 1960s. In more conventional times, increased demands would have been met simply by hiring more personnel. But the rate of increases, coupled with higher salaries and tighter city budgets, required city administrators to seek other management alternatives.

Systematic analyses of alternatives to improve performance and productivity have not generally been carried out in the municipal public sector, as has been the case in the private and defense sectors. The budgets of these services reveal that 90 to 95 per cent of expenditures are consumed directly by personnel: salaries, pensions, and related fringe benefits. At least through the late 1960s it is difficult to identify even as much as one-tenth of one per cent of total expenditures of most urban public safety services being directed toward research and development. But healthy, growing industries in the private sector typically allocate two to four percent of gross revenues to research and development. Police, fire, and emergency medical services, therefore, undoubtedly comprise some of the most labor-intensive, undercapitalized industries in the United States today.

In Cambridge, Mass., for example, the Police Department dispatches patrol cars by sectors, a plan which has not been redesigned for more than 20 years. Transition in population and neighborhoods has created marked inequities in patrol workloads. An officer assigned to the most centrally located sector recently complained to the planning and research staff about his police car radio. He was asked, "What is the matter? Doesn't it work?" He responded, "Yes, it works—that's the problem. Every time I'm free, I'm being sent someplace else in Cambridge on another assignment." The Cambridge Director of Police Planning and Research hopes to reduce this workload burden by exploring different sector design options with the aid of analytical models for sector design, dispatch selections, and preventive patrol allocation.

Our N.S.F.-R.A.N.N. (Research Applied to National Needs) program at M.I.T., "Innovative Resource Planning in Urban Public Safety Systems," aims at developing policy-related procedures and guidelines for improving the planning and decision-making in urban public safety systems, particularly police and emergency medical services. The research effort is broken into three components:

1. Development of a set of *analytical and simulation models*, useful as planning, research, and management tools for urban public safety systems in many cities.

2. A comprehensive analysis of *evaluation criteria* of urban public safety services, directed toward the understanding of productivity and effectiveness of urban public safety services.

3. An evaluation of the *impact of new criteria, methodologies, technologies, and organizational forms* upon traditional crime hazard rating schemes, insurance rating methods, related regulations and standards, personnel performance criteria, system operating policies, neighborhood service indicators, and employees and their organizations.

The research is strongly tied to cooperating agencies, especially in the Boston-Cambridge area, and additionally to other agencies throughout the country. The close interaction between university-based research and police and emergency medical agencies can provide early feedback from agency administrators regarding the validity of the underlying assumptions of the research and the potential utility of the research results. It is also designed to shorten the usual five-to-ten-year time span required from the inception and development of a research program through its successful implementation in the operating agencies. Current pressures for productivity improvement in the urban public sector demand that this time lag be cut to two or three years, wherever possible.

To facilitate the successful transfer of research results, our project is concerned not only with developing the technical details of various management and planning tools but also with obtaining a knowledge of the process of change within the institutions—particularly urban police departments and emergency medical services. This work requires the integrated efforts of sociologists, contemporary historians, urban planners, and police and medical professionals, as well as operations researchers, management scientists, and physicists.

Due to space constraints, we will focus in this article on the first research component—the development and use of analytical and simulation models for planning, research, and management.

Quantitative Tools in Perspective

The application of operations research and quantitative modeling to agencies with operational problems, such as urban public safety systems, is relatively new. Operations research established its first foothold in a

ENTER DISTRICTS TO BE SIMULATED (OR ENTER "ALL")

15

ENTER DISTRICTS YOU WISH TO MODIFY

none

DO YOU WANT TO CHANGE ANY VARIABLES?

yes

SIMULATION VARIABLES AND THEIR VALUES

1. LENGTH OF SIMULATION RUN = 2.00 HOURS

2. NUMBER OF CALLS PER HOUR =

DISTR.	1	2	3	4	5	6	7	11	13	14	15
	8	17	8	12	5	6	4	10	5	5	3

3. VEHICLE SELECTION METHOD = STRICT CENTER OF MASS

4. SERVICE TIME AT SCENE AND VEHICLE RESPONSE SPEED

PRIORITY	1	2	3	4
----------	---	---	---	---

SERV. TIME (IN MIN.)	33	33	33	33
----------------------	----	----	----	----

RESP. SPEED (IN MPH)	15	12	12	10
----------------------	----	----	----	----

5. TYPE OF SIMULATION OUTPUT = CITY

6. MORE DETAILED INFORMATION

ENTER NUMBER(S) OF THOSE TO BE CHANGED

1, 3, 5

1. ENTER THE LENGTH OF THE SIMULATION IN HOURS =

20

3. THERE ARE 3 VEHICLE SELECTION PROCEDURES, THEY ARE =

1. MODIFIED CENTER OF MASS

2. STRICT CENTER OF MASS

3. THE RESOLUTION OF A VEHICLE LOCATION SYSTEM

PLEASE ENTER THE NUMBER OF YOUR CHOICE =

2

5. DO YOU WANT CITY-WIDE OR DISTRICT SIMULATION OUTPUT?

district

KEY TO TABLES 1, 2, 3, 4

user instructions

COMPUTER INSTRUCTIONS

TABLE 1 Sample I/O Session

The above dialogue between the user and the computer occurs before the simulation model is run. One purpose of the dialogue is to set up values for certain simulation control variables that correspond to the length of time the simulation is to run, the method by which the dispatcher selects units to assign to calls, etc. The specific dialogue, above, results in three actions: the simulation run time is changed from two to twenty hours, the vehicle selection procedure is examined and the "strict center of mass" procedure is retained, and the level of aggregation of the output statistics is changed from city- to district-wide.

military environment approximately 30 years ago. Soon after World War II the classic steps of an operations research study—1. define the problem, 2. specify the objectives, 3. define criteria relating to the objectives, 4. specify alternatives, 5. compare alternatives, 6. present results, 7. implement recommendations—were found to be well-suited to operational problems in an industrial context. Indeed, both major areas of operations research—industrial and military—have flourished in the past 20 to 25 years. Special topic areas—inventory theory and transportation science—have emerged as individual applied sciences in their own right. In fact, it is a popular notion that operations research is by definition a transient applied science, to be utilized in substantive areas that have relatively little history of using systematic analyses. As the knowledge and experience in a particular substantive area grows, work in that area evolves from operations research to management science, traffic analysis, logistics analysis, or inventory control.

There are many documented cases of successful implementations of operations research—including modern inventory control systems and system control procedures for latest generation time-shared computers. Some implementations have been difficult, and in some cases there has been no implementation at all. Dangerous as it is to generalize over thousands of operations research studies, it may be said that the majority of successful implementations occurred in instances where either the objectives and constraints were very well defined (e.g., maximize profit, minimize probability of system failure) or the analysis included broader organizational issues. Examples of the latter include the impact of changes on personnel training, recruitment, and incentives, and even longer-term, fundamental changes in the system under study. The success or failure of many implementations has hinged on the degree of resolution of one or more of these issues.

A third major set of operations research applications emerging in the past two to five years is government service systems, including urban public safety systems. In these systems applications of operations research and systematic analysis are in many ways at the same point today as they were in defense systems 30 years ago. Although their complexity has usually precluded precise formulations, the urban public safety system's problems are now being identified, and the need for new methodologies has become apparent. The limited experience already available makes clear the necessity to carefully consider the broader organizational issues discussed above in connection with any application of operations research to urban service systems; without that broad viewpoint, there is little chance of successful implementation.

Implementation Difficulties

Why have the quantitative techniques, often referred to as operations research, not had an earlier impact on governmental service systems? The answer to this is multifaceted and difficult to fully determine; a few considerations are obvious.

First, objectives, performance criteria, and constraints for these systems are very difficult to isolate and define. One may state as an objective for urban public safety systems the "efficient, effective, and equitable distribution of quality emergency service, within rea-

sonable budget constraints." But it is hard to transform such sweeping statements into performance criteria that not only are easily measured but whose possible violation can be readily determined. Moreover, objectives for an urban public service may vary between administrators, operatives, and consumers. Travel time is one possible performance criterion, but its over-emphasis could result, for example, in the assignment of inappropriate personnel in response to a family dispute in order to save a minute of travel time, or in the assignment of inappropriate medical personnel in response to a cardiac arrest, again just to save a few seconds. Workload equalization among personnel, if followed precisely, could result in gross inequities in the type, quality, or rapidity of service delivered to various population groups. One soon begins to realize that a popular word in operations research, *optimization*, often bears little relevance to the operational realities of governmental service systems, primarily because of the difficulties in defining objectives and constraints.

Second, as system objectives are poorly defined, so too are measures of system productivity. Signals that a public safety system is not performing well are not nearly as apparent as a monetary loss in a particular year for an industry or a large cost overrun in the construction of a defense system. For example, if one city shows twice the per capita crime rate of another city, this may simply mean that the citizens and police in the former city are more likely to consistently and accurately report crimes that occur; or if a larger crime rate is a fact, it may be due in part to the number of transients who enter the city at 9 a.m. and leave at 5 p.m. There are many measures other than crime rate that reflect upon police operations in a city, making impossible such a statement as "City A's police department is better than City B's." Because productivity measures are lacking, those forces that would tend to favor the *status quo* within an urban public safety system often prevail. The alternative of "no change," while it assures that visible failure will not occur, makes visible progress more difficult to achieve.

Third, with their civil service orientation, these systems have tended to be insular, fraternal, and staffed with career employees whose average formal education often stops with high school. The high degree of job security creates an employee with an average of 20 years in one agency until removal either by retirement, resignation, or dismissal. Thus it often takes ten years to achieve a 50-per-cent turnover in personnel. Rapid innovation is likely to be frustrated unless there are receptive personnel in key positions. Implementation in governmental services, in contrast with their industrial counterparts, must be viewed as a multi-year process.

Fourth, until recently there has been no provision or motivation for agency administrators to call upon outside experts or consultants for assistance in helping to analyze operational and planning problems. It has been stated by well-known police administrators that outsiders, with no on-the-beat experience, have very little to contribute. This attitude in a manufacturing firm would require all executives to start as assembly line workers. Interaction of professional problem solvers and agency administrators has been unsuccessful until the recent initiation of federal funding programs. Moreover, in those few circumstances in which such interaction has been funded locally, it was often the one or

STATISTICAL SUMMARIES — DISTRICT NO. 15

THE AVERAGE PATROL UNIT SPENT 34.21% OF ITS TIME SERVICING CALLS

AVERAGE RESPONSE TIME TO HIGH PRIORITY CALLS WAS 6.40 MINUTES

AVERAGE RESPONSE TIME TO LOW PRIORITY CALLS WAS 7.27 MINUTES

AVERAGE TRAVEL TIME WAS 3.19 MINUTES

AVERAGE TOTAL JOB TIME WAS 34.59 MINUTES

Table 2 Sample LEVEL 1 Output

The above statistical summary is printed out after the simulation run is completed. Only five statistics are presented, thereby providing the user with a very concise and non-technical picture of the results of the run. If the results of the run are judged unsatisfactory, the user is likely to return to the input stage of the process. If the user is interested in more details on the current run, a more detailed summary can be requested.

two per cent of the budget for outside technical assistance that received the most careful scrutiny and, subsequently, the sharpest cuts. The fact that 90 per cent or more of the total budget is consumed directly by employee salaries and fringe benefits was apparently neglected. Thus, those outside are only beginning to discover the inherent operational problems of the agencies.

This distrust of outsiders has contributed to the delay in adopting technological innovations that could markedly improve performance and productivity in urban public safety services. One example is the underutilization of the computer; urban public safety systems, and many other governmental service systems, are years behind their industrial counterparts in bringing the computer's capabilities into day-to-day planning and decision-making.

Fifth, the operational behavior of urban public safety systems is complex and, at this time, poorly understood. This is due to several factors: 1. the exact times and locations of demands for services cannot be precisely determined in advance; 2. the time required to service an incident likewise is unpredictable; 3. there are many disparate high-priority requests for service; 4. emergency response units work cooperatively within a region, thus enlarging the number of highly interdependent status and performance variables; and 5. point-referenced performance measures (e.g., average travel time to an emergency at a particular address) as well as area-referenced performance measures (e.g., average

DO YOU WANT TO SEE LEVEL 2 STATISTICS?

yes

STATISTICAL SUMMARIES — DISTRICT NO. 15

AN AVERAGE OF 34.21% OF TIME OF ALL UNITS WAS SPENT SERVING CALLS
THE FOLLOWING UNITS WERE SUBSTANTIALLY BELOW THIS FIGURE:

UNIT NO.	UNIT TYPE	%
4	WAGON	0.00

THE FOLLOWING UNITS WERE SUBSTANTIALLY ABOVE THIS FIGURE:

UNIT NO.	UNIT TYPE	%
1	SECTOR CAR	79.14

AVERAGE TIMES FOR EACH TYPE OF CALL WERE AS FOLLOWS (STATED IN MIN.)

PRIORITY	DISPATCH DELAY	TRAV. TIME	RESPONSE TIME
1	0.00	1.60	1.60
2	5.06	3.40	8.46
3	0.00	0.00	0.00
4	3.72	3.55	7.27
	3.62	3.19	6.81

THE AVERAGE TRAVEL TIME WAS 3.19 MINUTES WITH REGULAR SPREAD
10.53% OF CALLS INCURRED A QUEUING DELAY DUE TO CAR UNAVAILABILITY
0.32 = AVER EXTRA MILES TRAV. DUE TO NOT DISPATCHING CLOSEST CAR
AVERAGE TOTAL JOB TIME (TRAV. TIME + TIME AT SCENE) BY PRIORITY WAS:

1. 77.54 MINUTES
2. 37.45 MINUTES
3. 0.00 MINUTES
4. 18.05 MINUTES

THE AVERAGE QUEUE LENGTH FOR EACH TYPE OF CALL WAS:

1. 0.00
2. 0.51
3. 0.00
4. 0.43

THE MAXIMUM DELAY IN QUEUE FOR EACH TYPE OF CALL WAS:

1. 0.00 MINUTES
2. 35.39 MINUTES
3. 0.00 MINUTES
4. 33.46 MINUTES

Table 3 Sample LEVEL 2 Output

This level two statistical summary indicates to the user which patrol units incur a workload substantially above or below the average. It also breaks down the response time into two components—dispatch delay and travel time—and into four priority classes. Additional statistics are given by priority class for total job time, average number of calls in the dispatcher queue, and the maximum delay time in the queue. If the user desires still more statistical information, a more detailed level of output is available.

region-wide travel time) are needed. Each of these factors adds complexity in the operational analysis of these systems; thus the understanding of the physical behavior of urban public safety systems is still far from complete.

There are undoubtedly other factors contributing to the difficulties of inaugurating the changes suggested by operations research and analysis into urban public safety systems. Identification of social, political, and bureaucratic factors is at least as important as the technical results of the analysis. We will use as much as possible the expertise of one or more of the administrators of the selected agency(s) to obtain the most realistic case study possible, often including ill-defined legal, political, and social constraints. A sense of the limitations of the particular quantitative method under study, the understanding and cooperation of the agency, and the agency's commitment to implement the method on a trial basis will also be obtained.

The Relevant Quantitative Tools

Several mathematical modeling methods are relevant to the analysis of urban services. One is geometrical probability. These techniques have not been widely applied to urban public safety systems, probably because most previous applications—astronomy, atomic physics, biology, crystallography, sampling theory, and virology—have been far removed from urban problems. Yet geometrical probability concepts are particularly useful for examining spatial interrelationships between demand for and distribution of urban public safety services. For instance, given the spatial distribution of police patrol units and incidents throughout the city, a police administrator using geometrical probability techniques can anticipate which neighborhoods would receive inadequate coverage in the event of an emergency, predict the workloads of police units in each of the areas, and calculate the likelihood that the *k*th closest unit would require more than *t* minutes to travel to the scene. Geometrical probability techniques are important in planning situations in which an administrator is examining the performance of alternative numbers and positionings of units in the field.

Generally speaking, the models using geometrical probability methods have the advantage of indicating first-order interrelationships among parameters. For example, such models can indicate in general the effect of adding more units in a certain region, installing a high-resolution car locator system, or designating particular

units as specialists in certain types of incidents. Rather than yielding the precise numerical "answers" that would come from a complex optimization model, geometrical probability models typically offer a range of policy options in which the user can incorporate additional political and legal factors. Thus the methods provide a general tool for analyzing operational questions, but they are not constrained by precise, inflexible solutions to the problems.

Multiserver Queuing Theory

A second class of relevant tools derives from multiserver queuing theory. A queuing situation evolves when a population places excessive demands on a limited-capacity service system—for instance, a city's ambulance service. If too much service is required in too short a time period, certain requests for ambulance service may have to wait in queue until ambulances become available to respond. An administrator would want to examine the trade-offs between the costs of additional ambulances and the delays incurred with different numbers of ambulances.

The important feature of queuing models is their ability to determine the close interrelationships between spatial positions of servers and demands and the time sequence of arrival times and service completions. They already have provided insights about where to locate ambulance garages and other facilities, where to put boundaries of service districts, the number of patrol units needed to provide an acceptable level of service, and the amount of cross-district dispatching likely to occur. Specific space and time interrelationships are relatively unexplored in queuing theory and provide an important area for current research.

A third class of tools uses the theory of mathematical optimization, subject to complex and interrelated constraints. Sometimes labelled "mathematical programming," these techniques (when carefully applied to urban public safety systems) are helpful in considering problems of transportation design, communication, distribution, and collection systems. Other applications are more unexpected; design of work schedules, work force size problems, design of hiring strategies, and optimal location of service facilities are among these.

When complex combinations of policy alternatives are contemplated in an actual urban environment, analytical models are used first to achieve certain insights and to indicate important unresolved problems. Simulation models are then used to examine the policy alter-



Quincy patrolmen are briefed on the latest crime patterns by David Fahrland, a member of the Planning and Research Division of the Quincy Police Department.

natives in detail. But simulation models applied to urban public safety systems present unusual problems not faced in customary applications. To be effective, such simulations must fully reflect the spatial relationships inherent in the operations as well as the sequential time nature of events which is common to many systems; that is, a fire at one point in a city may demand services of police and firefighters from several locations. The spatial organization must be general enough so that one can readily examine problems involving partitioning of a city into various service districts (e.g., ambulance or hospital districts, police patrol sectors, etc.), the spatial distribution of incidents and of response units within districts, and the determination of preferable dispatching strategies.

A Simulation of Urban Police Patrol and Dispatching

One simulation model presently being used in several police departments allows its users to closely replicate the actual dispatch and patrol operations of most urban police departments, thereby answering a wide range of allocation questions. Police administrators should find simulation models valuable for:

- Facilitating detailed investigations of operations throughout the city (or part of the city).
- Providing a consistent framework in which to estimate the value of new technologies.
- Increasing awareness of system interactions and the consequences of everyday policy decisions.
- Suggesting new criteria to monitor and evaluate actual operating systems.

A recent survey of some 500 police departments reported that police view the use of computers for resource allocation as the single most important application of computers in the coming years. Simulation models and other analytical tools should play an important resource allocation role.

The simulation can be easily sketched. Incidents are generated throughout the city, distributed in time and space according to observed statistical patterns. Each incident has an associated priority number, lower numbers designating the more important incidents. For instance, a priority 1 incident would be officer-in-trouble, felony-in-progress, or seriously injured person; a priority 4 incident could be an open fire hydrant, lock-out, or parking violation. As each incident becomes known, an attempt is made to dispatch a patrol unit to the scene. The computer in this assignment is programmed to duplicate as closely as possible the decision-making logic of an actual police dispatcher. His goal is to cover each incident quickly and effectively. When demands are too high, the dispatcher cannot cover every demand; then incident reports form or join a queue of waiting reports. The queue is depleted as patrol units become available.

The model is designed to study two general classes of administrative policies: the patrol deployment strategy, and the dispatch and reassignment policy.

The patrol deployment strategy determines the number of patrol units needed, the number of units assigned to overlapping sectors, the sectors constituting a geographical command, and the more heavily patrolled areas. The dispatch and reassignment policy specifies the set of decision rules the dispatcher must follow to assign a patrol unit to a reported incident. Included in the dispatch policy are the priority structure, rules about cross-precinct dispatching, the queue discipline, and so forth. Several important measures of operational effectiveness tabulated by the model include statistics on dispatcher queue length, patrol travel times, the amount of preventive patrol, workloads of individual patrol units, and the number of inter-sector dispatches.

The simulation program is organized to reflect the spatial relationships inherent in patrol operations as well as the sequential time nature of events which is common to all simulations. In the simulation, the city is partitioned into a set of "geographical atoms," each of which is a polygon of arbitrary shape and size. The atoms are sufficiently small so that spatial distribution within the atom (depicting, for instance, the positions of reported incidents) can be considered to be uniform.

A patrol unit's *sector* is a collection of atoms. The atoms in the collection need not be contiguous (spatially) or consecutive (in the numerical ordering of atoms). In general, each atom may belong to any number of (overlapping) patrol sectors. A patrol command (for instance, precinct, district, or division) is also a collection of atoms. Each sector must be fully contained within a command.

The simulation is an *event-paced* model. That is, once certain operations associated with one event are completed, the program determines the time until the occurrence of the next event and updates a simulation clock. The program then proceeds with the set of operations associated with that event. Once the clock reaches some maximum time (T_{\max}), the simulation is terminated and summary statistics are tabulated and printed out.

The most common event is a reported incident or a "call for police service." The calls are generated at random times consistent with average number of calls per hour from the region being simulated. The higher this number, the more likely it is that the system will exhibit congestion (saturation of resources). The location of each call is determined from historical patterns which indicate the fraction of calls that originate from each atom; its priority is determined from historical data which may vary by atom.

Once the position and priority of the incident are known, the program executes a DISPATCH algorithm that assigns a patrol unit to the incident. This algorithm is governed by the *dispatch policy* specified by the user, including a specification of the geographical area from which a unit may be dispatched; three policies are possible: *Option 1*: Only assign a unit whose patrol sector includes the geographical atom containing the incident (a sector policy). *Option 2*: Only assign a unit whose precinct or district designation is the same as that of the incident (a precinct or district policy). *Option 3*: Only assign a unit whose division designation is the same as that of the incident (a division policy, a division containing several precincts or districts).

Given that a patrol unit is within the correct geographical response area to respond to an incident, the algorithm then determines if the unit is eligible for dispatch to the incident. This determination focuses on estimated travel time to the incident, the priority of the incident, and the current activity of the patrol unit. In general, the user may specify a dispatch policy that allows very important incidents to preempt (interrupt) the servicing of less important incidents. In addition, the importance of preventive patrol may vary with each unit, thereby permitting the user to assure at least some minimal level of continuous preventive patrol.

If no unit is eligible for dispatch, the reported incident is inserted at the end of a queue of other unserved incidents. There may be separate queues for each command and each priority level.

If at least one unit satisfies the eligibility conditions, it is selected for dispatch according to a prespecified criterion such as minimal expected travel time. The assigned unit's priority status and position are changed accordingly.

A second major type of event occurs when a patrol unit completes servicing an incident. A REASSIGNMENT algorithm is then executed to reassign the returning

unit to an unserved incident or to return the unit to preventive patrol. The eligibility conditions regarding priorities, travel distances, and geographical areas, necessary to specify a dispatch policy, are also an integral part of the reassignment policy. It is also necessary to specify priority decisions about unserved incidents. This part of the reassignment policy, called the *reassignment preference policy*, parallels the *queue discipline* in ordinary queuing systems.

If not all available position information is used, or if the unit is performing preventive patrol, the method of estimating patrol unit position must be specified. Three options are available; two simulate estimation guessing procedures that are commonly found today in most police operations, and one simulates the information provided by a high-technology car locator system using such techniques as radio trilateration or inertial guidance to pinpoint each car's location.

Simulation Variables

The simulation program can tabulate statistics on any algebraically defined variable. The variables that have been recorded most often in the author's studies are:

- Total time required to service an incident—that is, travel time plus time at the scene.
- Workload of each patrol unit (measured in total job assignments and in time spent on jobs).
- Fraction of services preempted.
- Amount of preventive patrol.
- Travel time of a unit to reach the scene of the incident.
- Dispatcher queue length.
- Dispatcher queue wait.
- The number of intersector dispatches.
- The fraction of dispatch and/or reassignment decisions for which the car position was estimated rather than known exactly.
- The fraction of dispatch decisions which were non-optimal, in the sense that there was at least one available unit closer to the scene of the incident.
- The extra distance traveled as the result of a non-optimal dispatch assignment.

As will be discussed below, each variable may be tabulated at any one of several levels of aggregation.

On-Line Interactive Capabilities

Following the initial creation of the model at M.I.T., a number of individuals and organizations have modified and developed the model for various implementation purposes. One such effort, by R. Couper, K. Vogel and J. Williamson (1972), has been devoted to implementing a program that can be used by someone without detailed knowledge of computer operation, the simulation logic, or statistics.

The core of this package is a sequential tree structure which presents the options available to the user. If interest is expressed in a particular option, details of use are printed out at a level determined by the responses of the user. In the initial session the user specifies the particular geographical data base he wishes to employ, the patrol deployment policy, the dispatch procedures, the method by which car locations are to be estimated, the length of the run, and whether he desires to trace the simulation (and possibly interact with it) while in progress.

Following completion of the simulation, its results

DO YOU WANT TO SEE LEVEL 3 STATISTICS?

yes

DISTRICT SUMMARY

PARAMETER	OVERALL AVERAGE	STANDARD DEVIATION	MAXIMUM VALUE
1. WORKLOAD (%)	34.2	28.6	79.1
2. RESPONSE TIME (MINUTES)	6.8	10.9	39.8
3. TRAVEL TIME (MINUTES)	3.2	2.0	10.5
4. EXTRA DISTANCE (MILES)	0.3	0.4	1.2
5. TOTAL JOB TIME (MINUTES)	34.6	49.2	227.3
6. NUMBER OF CALLS PREEMPTED FOR HIGHER PRIORITY			= 0 (0%)
7. NUMBER OF CALLS ASSIGNED TO UNIT ON PREVENTIVE PATROL			= 17 (89%)
8. NUMBER OF CALLS ASSIGNED TO UNIT ASSIGNED TO SECTOR			= 17 (89%)
9. NUMBER OF CALLS ASSIGNED TO CARS OTHER THAN CLOSEST			= 7 (37%)

FOR WHICH PARAMETER DO YOU WANT A FURTHER BREAKDOWN?

1

PATROL UNIT	WORKLOAD BY PRIORITY				TOTAL
	1	2	3	4	
1	47.4%	17.6%	0.0%	14.2%	79.1%
2	0.4%	17.3%	0.0%	7.1%	24.8%
3	0.7%	19.7%	0.0%	12.5%	32.9%
4	0.0%	0.0%	0.0%	0.0%	0.0%

DO YOU WANT MORE DETAIL FOR ANY OTHER PARAMETERS?

yes

FOR WHICH PARAMETER DO YOU WANT FURTHER BREAKDOWN?

7

BY PRIORITY?

no

FOR WHICH UNITS?

all

CALLS ASSIGNED TO UNIT ON PREVENTIVE PATROL

PATROL UNIT	NO. CALLS	PER CENT
1	6	100.0%
2	6	85.7%
3	5	83.3%
4	0	0.0%

Table 4 Sample LEVEL 3 Output

The level three statistical summary represents the most detailed analysis of the run that the user may request. Statistics include averages, standard deviations, and maximum values of workloads, response times, and total job times. Certain new statistics, such as the number of calls assigned to cars not closest to the scene, suggest the magnitude of improvement possible by providing the dispatcher with an automatic vehicle locating system. Since many different statistical summaries are possible, the computer guides the user in selecting only those breakdowns that are of interest.

are summarized by a primary output, containing a small number of highly aggregated statistics: average travel time, average total response time (including queuing delay), average workloads, etc. This self-contained, self-explanatory output has been found especially useful for introducing police planners and administrators to the capabilities of the simulation and to quickly eliminate runs with poor performance characteristics.

The user may later request a more detailed output, which is less aggregated and provides average values of many variables by priority level; a sizable number of users will find this information useful in high-level planning and decision-making—for example, determining overall manning levels.

If the user desires even more detail, he can request detailed statistics which will be of great assistance in fine-grain planning, such as sector design. Experienced



A revision of patrol sector boundaries is suggested by running a multi-server queuing model. Here David Fahrland and another member of the Planning and Research Division discuss implementation of the new sector design.

users usually will demand this detailed output before making decisions which affect actual operating procedures in the field or at the dispatcher's position.

The program is also useful as a training aid, helping new users to learn the operation of the model and to develop a good intuition for system operation. In this mode of operation, the computer would ask the user to make dispatch or reassignment decisions and then demonstrates the results of these decisions.

Implementation

At the time of this writing (January, 1974), the simulation model described above and several other models developed as part of our N.S.F.-R.A.N.N. work are being implemented (or are planned for implementation) in Boston; New York City; Washington, D.C.; Quincy, Mass.; Gloucester Township, Canada; Newark; Cambridge, Mass.; Lowell, Mass.; and Ottawa, Canada. The work with Boston, Cambridge, and Quincy is supported as part of our N.S.F.-R.A.N.N. activity and focuses primarily on various analytical models for sector design, dispatch selections, and preventive patrol allocation. The remainder of the implementation work, supported by various other agencies, utilizes the simulation model.

Boston, Massachusetts

The Boston Police Department, on September 18, 1973, announced the largest change ever in its policies of patrol manpower allocation. The total number of cars on the street was increased from a daily average of 179 to 261, an increase of 46 per cent. Commissioner Robert J. diGrazia announced that the Department's new "Maximum Patrol and Response Plan" was the result of a five-month study by the Police Command Staff, the Bureau of Field Services, field personnel, and consultants.

A case study applying a recently developed queuing model to District 4 in Boston was written by the author in July, 1973, in response to a request from the Police Command Staff, and copies were distributed to the Boston Task Force. The initial focus was on District 4 because that district contained the entire spectrum of neighborhood characteristics found elsewhere in Boston. Thus, it was felt that if the plan worked in District 4, it would also work in the other Boston police districts.

Several quantitatively-based objectives provided the goals of the reallocation plan:

- Provide immediate response (i.e., no queue delay at the dispatcher's position due to patrol unit unavailabilities) for at least 95 per cent of all calls.
- Approximately equalize workload per car.
- Provide about 50 per cent of street time for patrol.

Ninety three per cent of calls were answered immediately during a trial implementation in District 4 using numbers of patrol units derived from queuing analysis, according to Deputy Superintendent Joseph M. Jordan.

Workloads were unevenly distributed prior to implementation of the new plan. For instance, cars in District 7 (East Boston) were answering calls for about three hours during the day, five hours at night, and two hours in the early morning shift. However, cars in District 11 (Dorchester) were answering calls for more than six hours during the day, constantly during the night shift, and more than seven hours during the early morning shift. Furthermore, District 11 cars during the night shift were often unable to respond to all the calls. The new plan, which attempts to give at least four hours to each car (in each shift) for preventive patrol activities, significantly reduces such marked workload inequities.

Examining the computational results of the case study, the Task Force felt that additional workload and travel time inequities due to geographical factors could be significantly reduced by formalizing a procedure for inter-district dispatching. Thus, a sector which may have been "outlying" in one district now may assume a new central role if its patrol unit is dispatched to calls in an adjacent district (and conversely for units in the adjacent district). The extra manpower required to implement the new Boston allocation policy was drawn from sworn police personnel performing clerical functions.

Quincy and Cambridge, Massachusetts

Use of the model by the Cambridge and Quincy Police Departments is still in a more preliminary stage. Both Departments are now collecting the data required to operate the model, and both are performing the sector redesign iterations themselves, using the interactive

computer programs developed at M.I.T.

The Quincy Police Department is performing a broad-based operational analysis under a grant for innovative planning supported by the Massachusetts Governor's Public Safety Committee. (This is the state planning agency in Massachusetts for the Law Enforcement Assistance Administration of the U.S. Department of Justice.) Part of this activity requires use of analytical and simulation models of police activity to improve planning and day-to-day decision-making. Quincy, located on Quincy Bay, has many natural and man-made barriers to travel, thereby limiting the number of feasible alternative sector designs. Members of the Planning and Research Division therefore are particularly interested in learning the magnitudes of the effects on performance discussed here in a Boston context. Using the queuing model, one civilian planner in Quincy has already investigated several alternative sector designs, testing differing numbers of patrol units with each design. The planner is currently briefing patrol commanders on the results of these model runs, and plans are underway to implement one or more of the new designs later this year.

Similar activities are anticipated with the Cambridge Police Department, which is now at the earlier stage of data collection for the model.

Washington, D.C.

An off-line version of the simulation model is being created and implemented for the Washington, D.C. Metropolitan Police Department, under the technical guidance of Mathematica, Inc., and with the support of the Law Enforcement Assistance Administration. Here the city's geographical structure is modeled as a set of discrete points, rather than polygons, each point corresponding to one city (surveyor) block. For Washington, D.C., this represents approximately 4,000 points—a sufficiently fine-grain detail to make the model useful for sector redesigns for the 138 scout cars distributed throughout the city. The selection of a point geography was possible because detailed block-level statistics are available for Washington. This effort started in January, 1972, and is reported in publications of Mathematica, Inc., and the Washington, D.C. Metropolitan Police Department.

New York City

The New York City Police Department in August, 1972, contracted with the New York City-Rand Institute to adopt the on-line simulation and a resource allocation algorithm to the special requirements of New York City and to implement these tools for analysis of the entire patrol force (distributed throughout 75 precincts in over 700 regular radio-dispatchable patrol cars plus special-assignment cars and radio-dispatchable foot patrolmen). The Department eventually plans to provide each precinct commander with a set of on-line decision tools within easy terminal access from each of the 75 precinct station houses. These tools would be used for short-term decentralized decision making as well as for longer term centralized resource allocation and planning and research. As of this writing, the resource allocation model has been implemented on the computer of the New York City Police Department, and police officers in the Department's Planning Division are using

Research in Architecture: Space, Services, and Attitudes

A Laboratory of Architecture and Planning? True, and it held a well-attended open house this spring.

The idea is to foster research by faculty and students which will contribute to the understanding, education, and practice of architecture and planning and closely related fields. William L. Porter, Dean of the School of Architecture and Planning, is Director, with David L. Judelson as Assistant Director. In addition to physical facilities, the Laboratory offers professional services through its Offices of Computing Services, Field Services, Research Administration and Educational Services.

Four major projects currently under the Laboratory's umbrella:

—**Urban Public Safety Systems** (Professor Richard C. Larson, '65): How to improve law enforcement, ambulance, fire and other systems in Boston and elsewhere, using advanced modelling techniques and limited interventions into the systems being studied. (The accompanying article describes the present status of this work.)

—**Public Urban Space** (Professor Stanford Anderson): How design professionals see and represent public space, urban form, and human activity.

—**Professional and Group Behavior** (Dr. Benson Snyder): The mental models which professionals construct of their professional-client situations in particular and, in general, the role of the human sciences in professional education in the M.I.T. School of Architecture and Planning.

—**Education in Environmental Design** (Mr. Judelson and Professor Gary R. Hack): The feasibility of a full-time one-year program in environmental design for early- and mid-career professionals.

the model to improve city-wide patrol manpower allocation.

Suggested Reading

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Richard C. Larson has served on the faculty of M.I.T. since 1969 where he is now Associate Professor of Urban Studies and Electrical Engineering. He has served as a member of the Science and Technology Task Force of the President's Commission on Law Enforcement and Administration of Justice and the Law Enforcement Advisory Panel of the National Commission of Productivity. He is president of Public Systems Evaluation, Inc., a non-profit technical services corporation.

Demands for environmental quality represent a new market. Like any other market, this one creates opportunities for profit. But it can also move a society toward a higher quality of life.



Public Markets: Growth Opportunities and Environmental Improvement

Whenever a new need is recognized and satisfied, a new market is created, and economic opportunities expand. This truism is accepted by economists and businessmen in all parts of the marketplace but one: environmental improvement. Instead, environmentalists, economists, and national leaders reiterate, tirelessly and almost hypnotically, that the country must choose *either* economic growth *or* a better living environment. They constantly question whether industry or society can "afford the huge costs" of environmental improvement. The public is offered the spectre of environmental collapse on the one hand, or unemployment, loss of living standards, and inflation on the other. For some reason, the complex, confused, and often emotional debates about life quality and the environment seem almost perversely to ignore the very real economic opportunities presented by the need for environmental improvement.

This article develops some opposite propositions:
—that environmental and life-quality improvement can be accomplished within wide limits, along with true economic growth,
—that such improvements can be achieved at a fraction of the "national costs" usually assigned to them, and with virtually no real inflation,
—that proper allocation of resources to these purposes will actually increase job and profit opportunities throughout the society,
—that, in so doing, a polity can be built to effect important value, attitude, and institutional changes essential for longer-term prosperity and environmental protection, and
—that these goals can all be accomplished within a policy framework reasonably available to decision-makers.

Population growth, geographical population concentration, technological advance, economic aspirations, and the acquisitiveness of producers or consumers have all been cited as root causes of the environmental crisis. Stopping any of these forces abruptly is simply not an option available to policy makers in either industry or government. But decision makers can effect important goal and policy shifts which will ameliorate the crisis in the short run and will make longer-run solutions more feasible. Many of these shifts lie in the economic realm.

A key element is a redefinition, not abandonment, of economic growth goals. Realistically, such goals must reflect people's continuing desire to be "better

off" in each succeeding year. But being better off need not, and even now does not, include just the goods and services individuals purchase. It also embraces health, education, recreation, safety, security, and even aesthetics, purchased jointly or publicly. If economic growth is defined—as ideally it should be—to include the per capita increase in such values, policy makers will have many realistic options to provide continued improvements in life quality along with continued expansions in job, investment, and profit opportunities. How can this work in practice?

Public Markets

Each dollar effectively spent on improved air, water, health, safety, or recreation employs people and economic resources to satisfy demands. Thus these are in reality new primary markets. And they are very large. (*See the table on the next page.*) Just like earlier markets for television, computers, xerography, or skis, they satisfy previously untapped demands and can support whole new industries. In short, they perform in all essential economic respects like any other primary market opportunities. The only difference is that individual resources and demands must be aggregated to create the markets.

Two examples will show how these "public markets" improve life quality and diffuse growth to almost all geographic and economic sectors.

—To clean up a river—and the shorelines and beaches it affects—requires sewage treatment plants, heat transfer units, improved storm drain and sewage systems, sophisticated monitoring equipment, and so forth. These in turn create multibillion dollar markets for steel and metal products, construction equipment, pumps and treatment equipment, meters, switches, wire, electronic controls, construction materials, glass, ceramics, plastics and chemicals. (*See the illustration on page 33.*) These demands then diffuse further to benefit the suppliers of these industries.

—A national commitment to make adequate health care available to all U. S. citizens would require expenditures of over \$110 billion per year in the late 1970s. (*See the illustration on page 32.*) A network of regional hospitals, local diagnostic centers, rural clinics, medical schools, special care units, and medical extension centers would have to be built and equipped. Large markets would be created for medical and dental equipment, hospital supplies, prosthetic and corrective devices, laboratory equipment and supplies, construc-

Annual expenditures in billions of dollars

	"C.E.Q. Fourth Report"	"To Live On Earth"	Other pub- lished forecasts
Air pollution	10.6	10	7-12
Water pollution	12.1	5-13	7-13
Solid waste	4.2	4-19	7-10
Land reclamation	.5	—	—
Radiation	.1	—	—
Medical and health services	—	—	110-167
Hospitals	—	—	5-7
Medical equipment and supplies	—	—	5-8
Educational systems	—	—	106-139
Roads and highway con- struction	—	—	15-22
Subsidized housing starts	—	—	3-10
Mass transit systems	—	—	1-2
Water supply systems	—	—	1-1.5

Estimates of the size of new markets that will be created by demands for an improved environment and quality of life. These demands—just like those for computers or mini skirts—will support new industries. The left column shows the average yearly expenditures, 1971 through 1981, predicted in the Council on Environmental Quality's *Fourth Annual Report, 1973*. The center column's estimates of the increase in expenditures, 1971 to 1975, are from *To Live on Earth*, by S. Brubaker.

tion materials, sanitary supplies, and so forth. These in turn would expand demands for chemicals, plastics, textiles, basic metals, metal fabrication, production and construction equipment, measurement and test equipment, and so on throughout all industry.

Interestingly, well over half of the product sales from these large new markets will ultimately diffuse to the basic production and construction industries. Although some of these are currently among the worst industrial polluters, the profit opportunities of public markets should provide a genuine self interest for such industries to support environmental cleanup. It is hard to imagine technological solutions to environmental problems which will not call for metals, cement, chemicals, or myriad other basic products. But such industries have tended to oppose rather than actively encourage public environmental programs. If understood, the potential growth opportunities for all sectors could encourage these and other business, political, and labor leaders to support the policy, institutional, and fiscal allocation shifts needed to generate public markets.

Aggregating Demands

How do public markets come into being? In some cases, government bodies will have to aggregate and dispense funds. The Highway Trust Fund, for example, has obviously allowed motorists to purchase transporta-

tion facilities they could not buy individually. And despite their undesirable side effects, superhighways have improved driving pleasure for millions, lowered transportation costs, and decreased traffic accidents and deaths. Their construction simultaneously provided a bonanza for many industries and companies. Following conventional wisdom, the oil industry vigorously opposed the gasoline taxes that created the Fund. Only later did the industry recognize itself as one of the prime beneficiaries of the markets produced.

In many other cases, government regulations aggregate demand to create markets with relatively little direct governmental expenditure. For example: Regulations of the Food and Drug Administration and the Department of Agriculture forced all companies to meet quality and safety standards that some producers opposed as too costly. But such regulations aggregated consumer demands for purer and safer products, allowed responsible manufacturers to charge for these qualities, and thus created the consumer confidence that was essential to the development of highly profitable mass markets for foods, drugs, and many household products.

Similarly, air and water quality regulations aggregate demands for better air and water quality. They force private and public groups to buy depollution devices, control systems, and structures they otherwise would

The table shows how the construction of a typical waste water treatment plant diffuses growth throughout the economy, creating opportunities in many markets. The figures are from *Water Pollution Control Facilities*, Long Range Planning Service, Stanford Research Institute, 1967.

	Per cent
Supplies	0.9
Metal products	11.6
Machinery and equipment (electrical, pumping, water treatment, meters, gages, etc.)	26.0
Stone clay and glass products	12.7
Lumber and other materials	3.1
Labor	28.9
Overhead, profit, etc.	17.8
Total	100.0

not. With relatively little government expenditure, a new industry—with its associated supplier, distribution, and service networks—is created. Even though air quality regulations may adversely affect an individual polluting industry, many industries can pass such costs through to customers with no real loss in demand. Others will gain markets as they substitute for heavier polluters. Still others will lower process costs through innovation. If the demand for clean air is valid and uncommitted resources are called forth to satisfy these demands, regulation of all industries with similar problems (for example: noxious stack emissions) can create a depollution industry whose value vastly exceeds the displacement losses of existing industries.

Properly developed and enforced pollution regulations can aggregate demands that people cannot adequately express in the market place, help insure that the full cost of a particular product is appropriately allocated among its producers, users, and the general public, and avoid the hidden subsidies produced when industries or users “externalize” excessive costs onto the public. Proper regulation thus becomes an extension of market place allocation of resources, helping to express fragmented demands and to introduce fuller cost considerations into producing and buying decisions.

Effluent charges are simply combinations of regulation and taxation which force the polluter to internalize costs more directly. In many cases, user taxes or effluent fees may be more politically desirable or more effective stimuli than general modes of taxation or direct regulation. This point is not at issue. Any of these approaches, properly implemented, can aggregate funds or demands to create public markets.

Self-Sustaining Markets

If they are correctly structured, most public markets will generate self-sustaining exchanges of earned incomes for desired goods and services—just like any other markets. Some people will buy cleaner rivers, safer cars or better health services; and others will produce the needed goods and services. Public markets merely offer a wider choice of possible services and values to the public. If priorities or opportunities for choice were different, monies and energies now expended on hair styling, chic clothes, or other consumer items could just as easily be spent for geriatric care, refuse removal, or park development. Many proposed environmental expenditures merely represent such priority shifts, refocusing demand from one market to another. And they should be treated within the

economic system just like any other change in consumption patterns.

In other cases, people are demanding clean air, safety, aesthetic values, pure water, or public health *along with* traditional products. They want electric power *and* clean air. A new value must be created in addition to the old. And if the demand for this value is real, people should be willing to pay for it as an addendum to product prices or through public purchases. Many have expressed skepticism on this point. But the issue has never been fairly tested for civil expenditures. Except for defense and space programs, public demands have not been given the intensive reinforcement and promotion that private demands constantly receive. Nevertheless the illustration on page 34 suggests that consumer demand for items requiring group purchases or supporting public facilities is growing faster than traditional markets. And the illustration on page 35 shows that, as a consequence, government expenditures are expected to expand more rapidly than most private markets.

Economic Growth

Can public markets actually create economic growth, or are they merely transfers of other demands?

Any opportunity, public or private, which calls forth previously uncommitted energies and resources can create growth. If an individual works harder and buys an automobile, his actions stimulate growth. If he and his neighbor jointly buy the car for a car pool, they provide an equal stimulus. If 1,000 citizens buy the same car as a public “school bus” they create identical sales, profits, and jobs. To the extent that environmental and life-quality demands are added to existing private, household, or public demands, they will provide a genuine growth stimulus—regardless of whether the expenditures are public or private.

Even if they are merely substituted for certain private expenditures, public markets can increase real output values. This occurs if the items publicly purchased are of higher relative value to the citizen than private items he could purchase for the same sum. For example: \$150 jointly invested in his town hospital’s diagnostic equipment could have measurably more value to a person whose life or health was saved than the same sum invested in a second television set. Even as insurance, the diagnostic equipment could have higher preference value than the TV set. Thus, as people begin to value life-quality and environmental improvement more highly than traditional products or services, equal en-

A forecast of future American expenditures on public facilities and other improvements of life quality that require group purchases. Though such public demands have not received the intensive promotion—through advertising, for example—that private demands constantly receive, expenditures on them are growing at a faster rate than are private expenditures. The estimates are from the Predicasts Forecasting Service of Cleveland, Ohio (October 26, 1973).

	Forecast of personal consumption (in billions of dollars)		Annual growth (per cent)
	1970	1980	1980/1970
Medical care	47.4	123	10.0
Transportation	77.8	173	8.3
Recreation	40.7	89	8.1
Education and research	10.4	22	7.8
Housing	90.9	192	7.8
Personal care	10.4	22	7.8
Household operations	87.4	183	7.7
Clothing, jewelry	62.8	130	7.5
Food and tobacco	141.2	276	6.9

ergies expended in these new directions could increase aggregate values produced even without increases in total resource inputs. In *Limits to Growth*, Meadows *et al* recognize that such increases in well-being can occur within the stringencies set by the authors' "equilibrium state."

Three conditions must be fulfilled for life-quality and environmental markets to create real growth: *First*, there must be some underemployment of people and capital in the society. Given uninvested savings, existing structural constraints on environmental investments, underemployed people ready to work, unused technologies which could free people for other tasks, and undertrained and poorly managed work forces, this condition is generally met. *Second*, the demand must be valid. Given comparable reinforcement of public and private demands, people must want (or need) life-quality and environmental improvements more than other goods and services that they could buy with the same resources. *Third*, adequate energy and natural resources must exist to supply existing and new demands. Without this, aggregate output clearly cannot increase. In the short run, such resources are available at a price. In the longer run they will doubtless force reallocation toward conservation.

Cost Fallacies

Granted these conditions, it is a major error to lump together—as environmental discussions so often do—all expenditures for sewage collection and treatment facilities, refuse disposal investments and removal services, health care facilities and operating expenses, stack and exhaust decontamination devices, and so on as "national costs" to be borne by the country. Only in the sense of other growth opportunities foregone may this be true. But no one ever asks what such "alternative costs" are of snowmobiles, mini skirts, phonograph records, restaurants, or second homes. These are simply regarded as markets—valid demands justifying the effort and resources needed to satisfy them. Why should environmental markets be treated differently? Obviously, monies effectively expended on needed equipment, construction, parts, or operating supplies for environmental markets both employ people and create demanded values. These clearly are not "overhead costs" to be absorbed by the society. Even the people hired to provide park maintenance, health care, or education are no more "national costs" than the barbers, waiters, or dry cleaners who provide other wanted services. They

are simply people productively employed to produce desired public values.

The true national costs—the costs to be absorbed without at least equal values being produced—of these markets is minimal. Assuming underemployed fiscal and human resources, each new person employed in an expanded field will create several new jobs in retail, service, or support fields. This is the familiar Keynesian multiplier. The taxes these people and their employers pay will easily cover the real "overhead costs" of regulation, collection, and dispensing of funds; indeed, they will pay for a large portion of the new services themselves. Add to this the innovative and economic stimulus of generally higher employment and demand levels, and these markets will not only be self sustaining, but will contribute to growth in other sectors just as primary markets normally do.

Cost Offsets

The nation is already paying many life-quality and environmental costs—without receiving any of the market benefits they could offer. Inadequate housing and medical care mean that people die earlier, are only partially productive, or are cared for by others whose efforts do not show up in national accounting. Underdeveloped public transportation and traffic control systems cost billions in personal delays, pollution, and equipment operating costs. Life risks are increased by inadequate safety controls, waste disposal, and air treatment systems. Polluted riverbeds, shorelines, and estuaries substantially reduce fishing, housing and recreational values. And irreplaceable estuaries, farmlands, forests, and natural recreation areas are destroyed by pollution and uncontrolled resource exploitation.

The recovery of these very real costs would reduce net environmental expenditures to miniscule levels. In fact, *Environmental Quality-1972* states that "in the aggregate the benefits of environmental improvement are measurably greater than costs." Explicit calculation of all such gains—and even gains in specific instances—is, of course, most difficult. But not recognizing them in public pronouncements creates a totally false image of the real cost of life quality and environmental improvements. The gloomy announcements accompanying release of the *Economic Impact of Pollution Control* and the \$24.6 billion Federal Water Pollution Control Act Amendments of 1972 provide typical and distressing examples of this phenomenon.

Costs for environmental improvements will un-

	Forecast of expenditures (in billions of dollars)		Annual growth (per cent)
	1970	1980	1980/1970
Personal consumption	617.6	1311	7.8
Durables	91.3	189	7.5
Non-Durables	263.8	545	7.5
Services	262.6	577	8.2
Gross private domestic investment	136.3	339	9.5
Government civilian purchases			
Federal (non-defense)	21.6	65	11.1
State and local	123.3	336	10.6

Estimates of increases in private expenditures and government expenditures other than on defense. The demand for environmental and life-quality improvement is reflected in a faster rate of growth for government expenditures during this decade. (Source: Predicasts Forecasting Service, October 26, 1973.)

doubtedly be further reduced by lower process costs from innovation or by-product use stimulated by environmental protection. A most dramatic—yet overlooked—example occurred in the early 1950s, when the town of Trenton, Michigan refused to allow McLouth Steel to install Bessemer converters because they produced too much air pollution. Because of its capital constraints, McLouth then went on a search for substitute low-cost processes, which led in 1954 to the first major U.S. installation of the basic oxygen process. When diffused through the steel industry, the cost savings and value gains from this highly profitable innovation will alone pay most of the steel industry's highly touted air depollution costs.

Reports in business journals (not presumed to be ecology minded) show myriad examples of similar savings in other industries, including: Dow's highly publicized savings in the chemical industry, the recovery of strip-mined land in Florida by American Cyanamid; and process recoveries in the mercury, oil, and paper industries, to name but a few. In *Science* for April 19, 1974, Charles A. Berg cites numerous examples of how industrial process costs were quickly lowered when engineers and managers turned their attention to the previously overlooked arena of energy conservation. Whenever a new criterion is introduced to design, it is inevitable that creative new options will be discovered; and environmental improvement will prove no exception. Because one would essentially have to predict specific inventions and innovations for each industry, no real estimate of ultimate process cost savings is possible. But they will doubtless be significant. Many industries' marginal costs and productivity should actually improve as high cost marginal producers modernize or disappear and new plants incorporate environmental needs in their initial designs.

Even when an industry's apparent costs rise because of depollution or safety requirements, this need not represent a cost to the industry itself. Many can pass these costs along to customers with little impact on either their primary demand or profits—provided all producers face the same restrictions. For example: electric power use is relatively insensitive to small price increases, especially as power shortages mount. Hence, if utility commissions act rationally, power companies' costs of water and air depollution can be passed through to customers while maintaining output levels, profits, and returns.

A similar pattern applies to many other polluting in-

dustries which are protected from foreign competition by transportation, location, scale, or other advantages. If the relatively small price increases estimated for most industries (*see* Environmental Protection Administration Report R5-73-016, April, 1973) cannot be passed along, then either the polluting industry is not marginally important to its customers, or good substitutes exist. In such cases, losses will normally be more than offset by increased demands for the industry which substitutes and for suppliers of the depollution equipment and services. Real losses can occur, however, when standards are set excessively high and with too little time for technological innovation. The '75/'76 automobile effluent standards are a case in point. Price increases to meet these standards may be so severe that new automobile and supplier sales could be significantly impaired. And little is gained if more polluting, older cars stay on the road.

The Real Costs of Environmental Quality

Despite such offsets, there will undoubtedly be some very real national costs for environmental improvement. But these are not the aggregate expenditures for environmental quality so often totaled up in public discussions. The only added costs the nation must absorb are those expenditures for which it does not receive compensating values of at least equal magnitude in return. What are these real costs?

First, *displacement costs* will occur as demand shifts hit individual industries, companies, and towns. Substantial industry-wide changes should occur only when one product or service can be substituted for another and their existing costs are very close—for example, in the case of coal versus oil fuels for central power stations.

Within individual industries, marginal companies may lack the capital, scale, or operating margins to install economic depollution equipment. For example, of the 12,000 plants in 14 polluting industries analysed in *The Economic Impact of Pollution Control*, pollution regulations seemed likely to close some 200-300 by 1976. Most of these were reportedly already marginal and likely to fail from other causes in a slightly longer time. And their displacement should be substantially absorbed by growth of the companies and industries which provide the substitute sources.

Nevertheless, individual and community losses can be very real in the short run. Total employment displacements in the 14 industries studied were estimated

	Billions of dollars
Incremental Gains	
A. Decrease in presently incurred costs	\$14
B. Employment and direct sales for air depollution	12
C. Keynesian multiplier effect	24
D. Values (beyond cost savings) of cleaner environment	2
E. Lowered process costs from innovation (steel only)	0.6
F. Lowered risks of ecological calamities	?
Added Costs	
G. Displacement Costs	0.4
H. Government Bureaucracies	0.2
I. International Trade Losses	0.7
J. Improper standards	avoidable
K. Inflation in other products' costs	negligible

A comparison—necessarily crude—of the costs and gains of air depollution. Figure A is from page 1-11 of *Economics of Clean Air*, E.P.A., 1972. That report estimates the total costs incurred by air pollution at \$24.9 billion. Figure B is from the same report, page 1-14. It does not include an assessment of the health effects of carbon monoxide, hydrocarbons, nitrogen oxides, or ozone. The Keynesian multiplier of Figure C is conservatively estimated to be two times Figure B. Figure D is based on a Gallup survey of attitude toward environmental clean-up reported in *National Wildlife*, April-May 1972. Better ways of estimating this quantity are needed. The source of Figure E is *Manufacturing Policy in the Steel Industry*, Skinner and Rodgers, p. 12-13. Figure G is calculated from figures in *Economic Impact of Pollution Controls*, C.E.Q./E.P.A., 1972. Figure H—from page 1-2 of *Economics of Clean Air*—covers the cost of the E.P.A. plus \$64.5 million for state and local governments. Figure I is from page 322 of *Economic Impact of Pollution Controls*. Figure K is given as “negligible”; if it has any value, it will be caused by increased total demand. Clean air should cause no inflationary effects on other products if it has a value higher than its cost.

at 1.4 per cent of their current employment or .05 per cent of total employment. But such displacements appear minor compared to those caused annually by consumer, government, and industry decisions in other fields. Automobile styling changes, aerospace and military contract shifts, and fickle consumer fads create far more displacement each year than that estimated for environmental investments. Unfortunately, environmentally induced displacements create an amplified political clamor because the institutions which cause them have not yet been accepted as being legitimate “market mechanisms.”

Second, *government bureaucracies* could become the dominant non-productive costs of environmental improvement. Unfortunately, past experience with regulatory and social expenditure groups suggests that bureaucracies develop a growth syndrome quite independent of their functions. In some cases this only results in inefficiencies. In others, agencies essentially cease performing their intended functions or become captives of the industries they are supposed to regulate. Still others—like those in early public housing and welfare efforts—actually become counter-productive. Unlike displacement costs in industry, where someone's loss eventually becomes someone else's gain, bureau-

cratic costs can become both high and permanent. Efficient fees, wherever they are practical, offer some hope for avoiding the worst abuses.

Third, *improperly established or maintained standards* can inflate costs, create unnecessary displacement, and make rational progress difficult. Towns or companies have often invested to meet one set of standards, only to immediately encounter new demands which they could have met less expensively at the time of their earlier investment. Some standards—like those which moved 1980 auto exhaust emission standards ahead to 1975-76—are set with too short a time horizon, forcing effort and investment into designs that represent costly, ineffective solutions. Costly, but politically visible standards—like the National Highway Safety Administration's much discussed goal of “passive survivability” in 50-m.p.h. head-on collisions—can absorb energies that are better devoted to seeking lower-cost, high-yield approaches, like drunken driver regulation. And pressure groups may seek absolute safety through standards, although costs tend to grow exponentially for increasing increments of protection.

Fourth, *international competition* poses special displacement problems. Foreign products shipped into the U.S. will, of course, be subject to U.S. standards. But the U.S. products can face price disadvantages both in the U.S. and abroad if lax environmental standards allow lower production costs abroad. *Environmental Quality* (1971) noted that heavily polluting industries account for some 18-19 per cent of U.S. foreign trade. And Chase Econometric Associates estimated a possible loss of \$700 million per year in U.S. trade balances through 1976. But neither study assessed the probable rise in foreign pollution standards or the impact of U.S. exports of environmental control devices and know-how. Moreover, U.S. multinational companies with production bases abroad will share in relative foreign gains. These factors suggest that foreign trade losses should be minor compared to the potential new multibillion dollar markets created in the U.S.

Increased depollution costs appear considerably less significant to the U.S. international competitive posture than other potential variable cost increases, such as labor rate changes. For example, a 5 per cent wage rate increase has much more cost leverage on trade than estimated pollution abatement costs. American buyers can, of course, lower their costs by importing items which are produced more cheaply abroad, and American companies can ship polluting products to countries where they are not yet regulated. Thus, the primary effects from foreign competitors (if currencies are allowed to seek their own values) should be a mix change in the U.S. import-export structure and some temporary displacement costs resulting from this change. These can be vastly outweighed by the value of new public markets created in the U.S.

Fifth, *inflationary effects* have generally been overstated. The Chase Econometric Associates study suggests that the consumer price index in 1976 will be a moderate 1.2 per cent higher as a result of environmental controls. But even so, the study assigns essentially no value to outputs of clean air and water, safer products, and so forth. Output is measured in the same way as before environmental improvement—that is, in physical product terms, such as cost per auto or kilowatt produced. In reality, of course, a new value is be-

ing created (*safer, cleaner autos or power plus clean air and water*). Price increases for environmental purposes thus represent essentially the cost of a new product or service. So long as this new product's value to the public exceeds its marginal cost—and policy should see that it does—this should cause no real inflation in the original product's costs. Whatever inflationary pressures do occur will result primarily from the increased *demand* environmental improvement places on energy or natural resource systems. Industry merely has an opportunity to sell a product or service it could never sell before. In any other field, industry would be delighted by this state of affairs.

Costs vs. Gains

Approaching environmental and life-quality demands as new and unsatisfied markets reshapes costs-versus-gains calculations in a new and constructive light. Figures cannot be provided for all such markets, because necessary estimates do not exist, and actual values will depend on policies selected. But assuming underemployed resources and a valid demand for air quality improvement, some crude estimates can suggest the nature and relative magnitudes of the incremental gains versus added costs of satisfying the market for improved air. (*See the table on the facing page.*) The "net gain" from such a calculation must, of course, be compared with the next most attractive use of the same funds, to establish the value (or alternative cost) of other benefits foregone.

We make no claims about the precision of individual estimates. They are taken from standard sources. But in most environmental fields, one would expect gains A through D to be *each* of a magnitude comparable to the *total expenditures* for the environmental improvement involved. E and F would have significant values, but could not often be calculated in advance. By contrast, costs G through I should be a tenth to a hundredth of total expenditures. Real inflation should be negligible; and (potentially, at least) improper standards costs could be kept to a minimum. Thus, if life quality and environmental demands are approached as public markets, net benefits should exceed expenditures by several times. As compared to such benefits, real costs to the society should be very small—a tenth to a hundredth of the values and growth produced.

None of the above suggests that a society should adopt policies to "pollute itself to prosperity." Policy makers should still seek the lowest cost means of satisfying each demand. And they must still trade off the relative costs and gains of using these resources to produce other values for the society. But in making these tradeoffs it is only fair to compare like quantities. Employment and sales impacts, Keynesian multiplier effects, values produced above more cost savings, and lowered costs or risks to the society all deserve to be included in the gains matrix, just as they are in evaluating gains from private market (or even welfare) expenditures. Against these should be cast the real marginal costs of each action as defined above. The resulting "net gain" can then be fairly compared to other policy options calling for equal resources.

Cost/benefit analyses developed this way could show—dramatically and properly—much greater incentives for life quality and environmental improvement than decision makers or the public now perceive.

Long-term Issues

A public markets approach recognizes a congruence of interests among environmentalists, politicians, and economic leaders. Hopefully, therefore, it can help create a policy to effect necessary short-term redirections of policy. These are essential in developing the attitude and institutional changes which must underlie longer-term cultural and biospheric solutions to the potential imbalances between man and his environment.

Opportunities for environmental and life quality improvement are interlocking and will grow together. Companies seeking to exploit one public market will soon find they must accept—and even encourage—environmental controls over their own effluents or health hazards. The public will not support expensive sewage disposal and medical care systems while industry continues to dump its effluents into the water and air. Road and highway construction will lead inevitably to demands for some place to go: open spaces, parks, clean lakes or rivers. And clean air and waters will lead to recreational development, refuse disposal, health care, transportation, and other living demands. As progress and opportunities diffuse throughout the society, industry, labor, and political leaders could increasingly find their self-interests tied to environmental improvement. This should help to achieve needed short term priority shifts. But what about the long run?

Eventually man must learn to limit his populations, recycle his raw materials, maintain the earth's capacity to reproduce renewable resources, and control his effluents to sustain balanced ecological systems. Public markets can lead to and support these goals. By requiring lower effluent levels and charging full costs to former polluters, consumption patterns can be shifted toward lower polluting activities. Increased purchases of low pollution services like health care, education, refuse disposal, and recreational or open areas will further shift demands toward less dangerous or harmful production activities. As raw material shortages and disposal costs increase—and as people see the increased value of a better environment—recycling can itself become a public market employing people to produce useful environmental values.

Once the concept of satisfying public demands becomes accepted, and institutions are constructed to implement these demands, it becomes possible for the economic system to produce any desired mix of product, service, private, or public outputs. If the demand system dictated, one could imagine an economy in which a large percentage of the population was employed to produce health care, education, personal, and leisure services; essentially all critical materials and effluents were recycled; and a relatively small, highly automated, sector produced enough products for all.

The primary limit to the total output of such a system would be its energy conversion technology. A very efficient, low polluting energy system—like a fusion-hydrogen system—could allow a very high living standard in both material and life quality terms. And this standard of living could grow steadily and meaningfully as better and more efficient services were produced year by year.

The very processes which made such a society possible would help create the values needed to solve other, more basic social and ecological problems. Full employment would be essential. Slums could be an

anachronism—as they are in most of Scandinavia today. Mild affluence, health care, and education could decrease some traditional pressures for large families. And a more favorable climate would exist for rigorous control of harmful biospheric agents (like pesticides) or other dangerous chemicals entering food chains. One cannot, of course, predict that these would be results of developing public markets. But there is certainly nothing in the concept which is inherently counter to long term environmental needs. Instead, public markets should provide an important first step in a complex evolution of values and institutions to meet such needs.

But these markets cannot be brought into being without dealing with some important policy issues. Public and private groups will have to work together more effectively than they have in the past. Key problems are: stimulating sufficient public action to generate an effective demand system; setting and maintaining proper standards; and developing institutions to avoid the regulatory nightmares, bureaucratic potholes, and fraud which have plagued past public-private efforts in the U.S. One could not hope to specify a complete set of answers to these complex questions here and now. But certain policies, attitudes, and actions seem essential.

Stimulating Public Action

Expenditures for life quality and environmental improvement should be justified not on cost savings alone but on the full range of benefits they provide. Cost savings analyses can only show the *minimum* a society should be willing to spend to break even in an economic sense. Beyond this are all the very real qualitative values of living in a better world. All other demand systems respond to such values. People buy higher quality homes, automobiles, food, furniture, and clothing than are absolutely essential because these items have values beyond mere trade-offs of cost vs. dollar savings. Why shouldn't the value of environmental improvements also be allowed to extend beyond simplistic cost/benefit calculations? Opinion makers should recognize—and appeal to—these values, just as they would in other markets.

Environmental improvement must be actively promoted and advertised to create and maintain public demand. The average person now spends more time in contact with TV and other media than in any other waking activity except his job. And these media are prime creators of personal and public values. Given the

constant barrage of commercial messages that Americans receive from every written and wireless medium, roadside vantage point, or window display, an active campaign is necessary to see that people do not continue to develop their expenditure patterns with a large void where social preferences should exist. The extensive increase in the general population's concern for environmental affairs in the last five years was largely stimulated by programs, news stories, and advertisements in the mass media. This experience suggests that a relatively few private advertisers directing only a small percentage of their total promotional and program budgets toward public needs—if properly supplemented by media reporting, government, and conservationist efforts—can develop and maintain public awareness at a level sufficient to permit needed political action.

Setting Standards

Despite some short-term arguments to the contrary, enforced nationwide minimum standards are essential. Otherwise some local groups will lower standards to an unacceptable level or will lack the will to enforce them. Such situations create competitive inequities, put first installers under unnecessary stress, and reward those who act most irresponsibly. They also place local polluters in a stronger bargaining position relative to those most affected by their pollution; the polluter can threaten, for example, to move to a lower-cost location. Some heavily-impacted regions will, of course, have to set *tighter* standards than the national minimums. And stricter standards will be needed for protected natural areas. But national minimums are needed to insure all citizens certain basic living quality rights and protect the nation against the hazards of pollutants—like sulphur and nitrogen oxides—which geographically disperse because of natural phenomena.

For example, there are recent indications that rain-falls in northern New England are averaging pH 4.2 to 4.6, with incidents of much greater acidity (*see February, pp. 8-9*). Sulfur and nitrogen oxides carried by wind currents from the west appear to be major causative agents. Without national standards to discourage biospheric buildups of such pollutants severe economic and ecological damage can result. Local controls in New England will be useless; only national minimum effluent standards can be effective.

Standards should be set well in advance. Except in emergency cases, like severe toxic contamination, they

should normally be announced at least three to five years before their effective dates, and broad guidelines should be projected a decade ahead. This would allow towns and companies to minimize costs of plant location, process and design changes, fund raising, and capital commitments. Longer lead times would also allow technological developments that would otherwise be precluded. Industrial participation, without dominance, in standard setting should be encouraged for realism and for informational purposes. For those making commitments, predictability of regulation is almost as important as the specification itself. Projected standards can prevent some of the punitive effects of shorter term regulation and hopefully avoid many law suits and delays.

To stimulate innovation, performance standards or discouraging effluent fees—not product or component standards—should be used whenever possible.

Improving Government Agencies

Healthy regulatory and public purchasing agencies are the ultimate ingredients in public market development. No one can specify a complete solution to this complex problem. But certain minimum criteria seem essential to avoid past disasters.

Whenever possible, regulatory agencies should be supported by a competent laboratory system which allows them access to technical expertise comparable to the industries they affect. Expenditures and regulations must be coordinated over logical problem oriented regions, not by state and local governments, unless they happen to conform to these regions. Recently developed quasi-governmental "authorities"—such a regional transportation, river basin, and air quality, commissions—may offer a logical starting point for such coordination. If properly funded and developed as the regional arms of national agencies, such groups could develop system-wide solutions to specific problems. States could perhaps serve a monitoring function to see that regional groups are effective in meeting area needs.

The basic problems of U.S. regulatory and expenditure agencies will never be effectively resolved, however, as long as political leaders must finance their campaigns extensively from private or institutional gifts. The implicit threat of losing this support makes the politician dependent on special interests instead of his whole constituency. These interests will inevitably be reflected in the individual politician's relationship to regulatory and expenditure agencies, and in these

agencies' over-response to potential pressures from these groups. New methods of financing political campaigns deserve top priority for this and other public policy reasons.

Many institutional innovations will be necessary to make any solution effective in light of the quiltwork of existing political and pressure centers. Unfortunately, society has yet to invent the much needed, functionally active, bio-degradable government agency. But the need is great, and the task is not impossible.

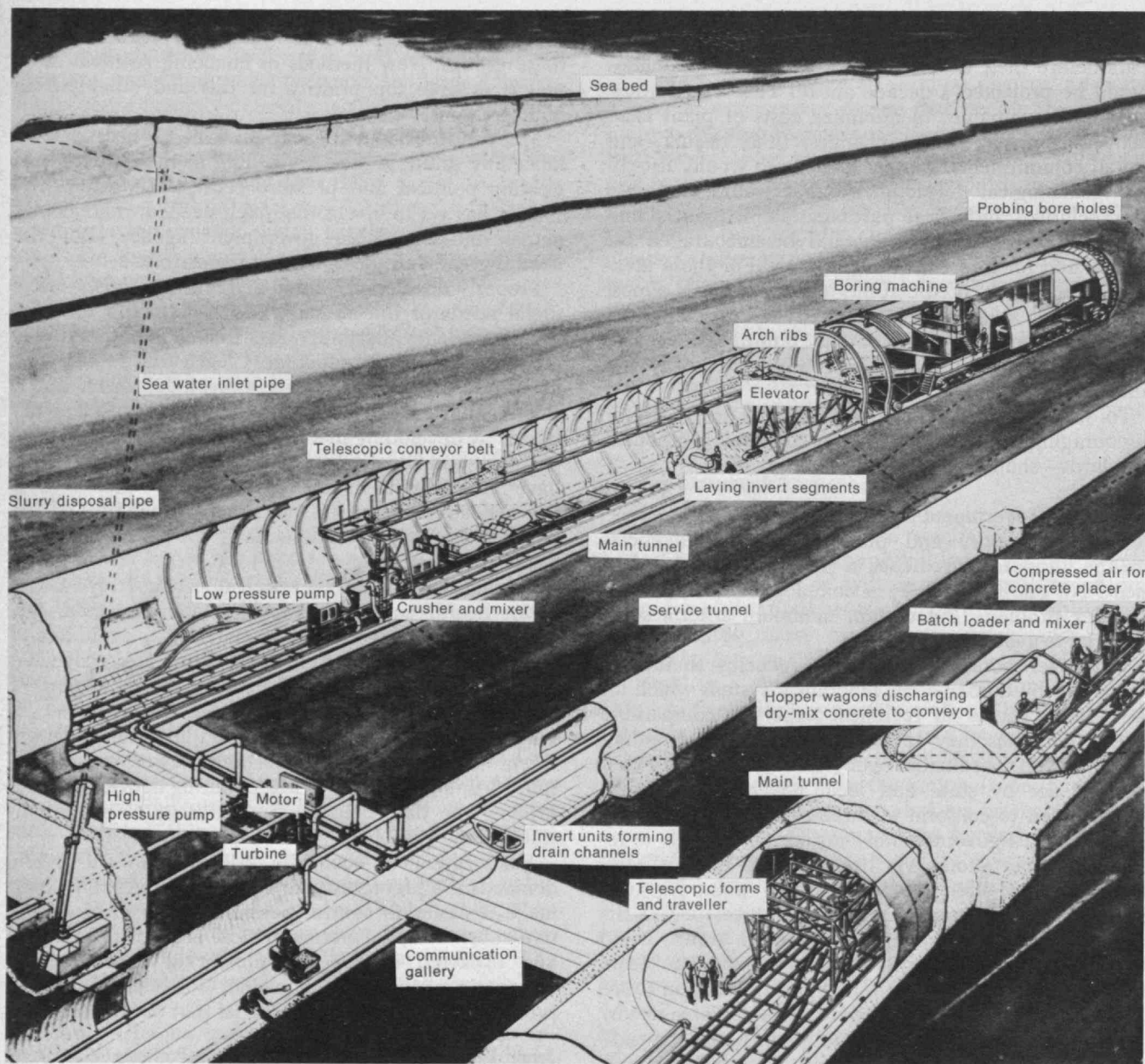
Properly developed, public markets can satisfy many social needs of the nation while maintaining the economic efficiency, flexibility, and free choice strengths of private enterprise production. Clearly the society can not produce or consume ever more indefinitely. But it can—within wide limits—continuously increase its well-being, by developing mechanisms to allocate its human, physical, and fiscal resources to those problems which have most value to its citizens. To do this, citizens must have effective means for including life quality and environmental improvements among the values they can select for a better life.

"Living better" can mean improving recreational areas, health care, education, or environmental surroundings (and even recycling materials to avoid loss of forests or natural areas). If these efforts are recognized as satisfying demands—and hence properly a part of economic output—real growth can be achieved in values produced as well as improved life quality. To the extent that such output consumes fewer natural resources or shifts efforts to less polluting activities, it can prolong the time before ultimate limits or critical instabilities are reached.

Reallocation of economic priorities toward public demands is a prerequisite to attitude changes that could make it easier to control potentially dangerous bioactive substances, to protect critical ecological balances, and to avoid further despoilment of natural areas. Economic changes alone cannot solve all ecological problems. But they are an essential part of the process.

James Brian Quinn is Nathaniel Leverone Professor of Management at the Amos Tuck School of Business Administration, Dartmouth College. He received his B.S. in engineering from Yale University, his M.B.A. at Harvard University, and his Ph.D. in economics from Columbia University. Professor Quinn is a consultant in long-range planning and research management to several European and American companies, and has written numerous articles on technology transfer, science strategy, research and development management, and related topics.

A long-discussed project is now providing macro-engineering with a new model for finance and management research and for stimulating communication between governments and the professions



For 32 miles between Cheriton, near Dover, and Fréthun, near Calais, the chalk formation under the English Channel will soon yield to tunneling machines, conveyors, and high-pressure concrete. After five years (starting in 1975) and \$2.1 billion, trains in two tubes could be moving freight (5 million tons per year, think British Transport officials) and passengers (15 million annually) and their motor cars between Britain and the Continent. But its uniquely large engineering achievement is only

one aspect of the Channel Tunnel project which intrigues the author. He thinks its launching is "likely to accelerate serious consideration of a host of other major infrastructure projects," and he believes its organization may be a prototype for groups confronting tasks where "engineering, legal, financial, environmental, and philosophical skills" must be integrated.

Tunneling the Channel

While Western European political leaders continue to strive for economic and political accommodation, engineers from Britain and France have begun to build a permanent physical link between the Continent and its principal "offshore island"; and this may do more than any political act to forward the elusive goal of economic unity.

In England, some differences of opinion remain as to the proper role and scope of "chunnel"; but there is a good chance that, if the final parliamentary steps are taken as presently envisaged, the two governments will have a mandate, before the end of 1975, to authorize the completion of Europe's greatest enterprise since the construction, during the reign of Louis XIV, of the *Canal des Deux Mers* linking the Atlantic Ocean and the Mediterranean Sea.

The Anglo-French Treaty signed on November 17, 1973, set up guidelines for the finance, building, ownership, and management of "a Railway Tunnel System under the English Channel". Work has now been under way, above and around the chalk cliffs of Dover and Calais, for more than half a year, with the object of pushing out a pilot tunnel nearly two km. from each coast by the middle of 1975. The Channel Tunnel Bill sponsored by Prime Minister Harold Wilson's Labour Government, and fully supported by the Conservative Party as well, passed its second reading in the House of Commons on April 30, 1974, by the decisive majority of 287 votes to 63. This assured independent, up-dated re-assessments of costs, revenues and other factors, and also the continuation of preliminary construction work.

Before the end of next year, the British and French governments will decide whether to proceed with the completion of the pilot tunnel and the construction of the two main tunnels—one for railway traffic to England, the other for railway traffic to France (with automobiles, trucks and buses riding piggyback on specially designed flatwagons). The cost of the project, inclusive of the marshalling yards, freight and passenger terminals, access roads, and supplementary installations, has been estimated at almost \$2 billion at current prices. If a new high-speed line to London, along with similar improvements on the Continent, should be authorized, a further half billion could be added to the eventual cost.

This is "macro-engineering" on the grand scale; it should not be surprising that the initial phase—the commencement of a pilot tunnel (later to be used for service and access from both coasts)—was only agreed

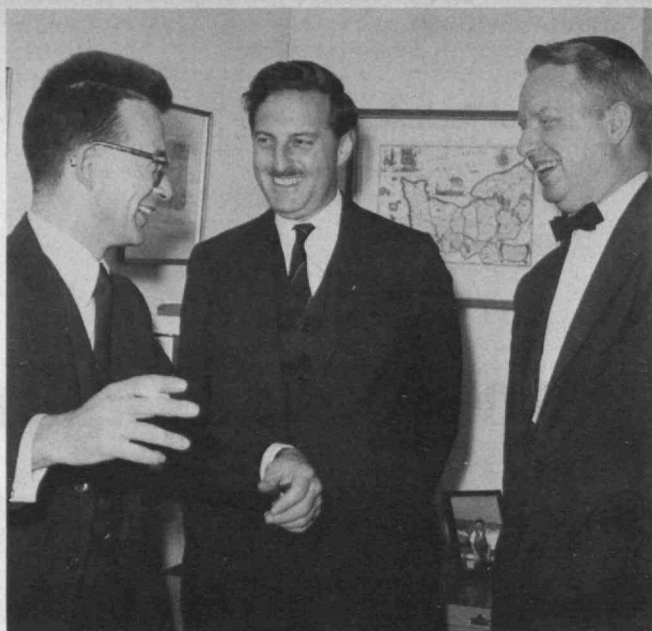
to after "agonizing re-appraisals" of the economic, environmental, social and political costs and benefits.

Discussion of the "chunnel" seems first to have been made a matter of record by the Academy of Amiens during the reign of Louis XV. In 1751 Nicolas Desmarests won the Academy's prize for the best plan for a "dry-shod" connection with the British Isles; he surmised, correctly as it turned out, that the lower chalk strata were continuous from shore to shore and that in pre-historic times Britain had been a true peninsula of Europe. The tunnel bored through the "lower chalk" which was described and recommended by Monsieur Desmarests was not very different in principle from the modern project whose initial stages are now under construction.

The history of the various nineteenth century proposals to "bridge the channel" has been charmingly recounted by Thomas Whiteside in his book, *The Tunnel Under the Channel*, which first appeared in serial form in *The New Yorker*. The present article will be concerned rather with more recent vicissitudes of the project, its implications for other macro-engineering ventures around the world, and a few of the lessons concerning concept and organization which might prove helpful in the assessment and planning of major infrastructure installations in North America.

The signing of the tunnel treaty in November was a full-dress affair. Prime Minister Edward Heath and the late President Georges Pompidou met at Mr. Heath's official country residence at Chequers and drank champagne as their Foreign Ministers signed the treaty. Meanwhile, at Lancaster House in London, British Transport Minister John Peyton and his French counterpart, Pierre Billecocq, signed an agreement with the Société Française du Tunnel sous la Manche and the British Channel Tunnel Company Limited—and with each other—setting out the technical and financial arrangements. "It will be easier for you to come and pick our roses of Picardy and, for us, it will no longer be a long way to Tipperary", said the French Transport Minister. Five days later, *The Times* (of London) carried the following report: "Workmen began levelling land today near the top of Shakespeare Cliff at Aycliff, Dover, in preparatory work. . . . From that site an underground road tunnel is to be driven down through the 300 ft. high cliff to a coastal shelf. . . . From the coastal shelf, where Channel tunnel borings started many years ago, another boring will be driven downwards at a one-in-seven gradient. A

By the beginning of 1957, though the project was attracting significant attention in Britain and on the Continent, there was no source of detailed planning and funding for a Channel Tunnel. But in that year there were established a broadly based Channel Tunnel Study Group and a New York corporation, Technical Studies, Inc. to fill these voids. The founders of Technical Studies (top) were Arnaud de Vitry (M.I.T. S.M.'51) (left), Chairman; the author as President; and Cyril C. Means, Jr. (right), recently Arbitration Director of the New York Stock Exchange as Executive Vice President. In the lower photograph several members of the Conseil de Surveillance of the Channel Tunnel Study Group pose at a showing of the Technical Model of the French tunnel terminal at Galeries Lafayette, Paris, in December, 1962: M. de Vitry, Charles de Wouters, Louis Armand, Leo d'Erlanger, Rene Massigli, Paul Leroy-Beaulieu, and Alfred E. Davidson.



two-km. tunnel will be driven from the end of the new boring under the sea on the line of the Channel Tunnel." Work was begun simultaneously on the French side to build the access shafts and 1.5 to 2 km. of the service tunnel.

From Death to Life in 20 Years

But as recently as 1956, the project had appeared to be a dead issue. Harold Macmillan, Minister of Defence, had given a broad hint in 1955, in response to a question in Parliament put by Joseph P. W. Mallalieu (Labor Party Co-Chairman of the all-party Channel Tunnel Parliamentary Committee) as to the old military objections to a channel tunnel, that there were "scarcely any." Leo d'Erlanger, indefatigable leader of the Channel Tunnel Company, Ltd., had made useful preliminary contacts with Paul Leroy-Beaulieu and other

influential personalities in France. But there was as yet no detailed plan of campaign, no mechanism for co-operation and no source of funds for the necessarily slow and painstaking work of analysis, design and negotiation.

The void was filled by the establishment of a Channel Tunnel Study Group in July, 1957. In March of that year, a New York corporation, Technical Studies, Inc., had been formed with the sole object of sponsoring investigations into the feasibility and desirability of a channel tunnel. The American initiative was well timed, and it evoked a favorable response in London and Paris, of which an editorial in *The Economist* on April 13 was typical: "From the status of a stale joke, the Channel Tunnel has suddenly regained that of a serious possibility. The resurrection is, so far, partial and tentative; the Government's interest in it seems to have

been aroused by a strictly limited initiative by a group of American experts, Technical Studies, Inc. This small body of engineers, lawyers, and businessmen has seen a favorable constellation of circumstances in the closer economic links projected between Britain and the Continent, and the fact that pre-war military fears about the project are now obviously nonsense. . . .

Soon afterward, the French Academy invited the chairman of Technical Studies, Inc., Comte Arnaud de Vitry (a former M.I.T. graduate student) to deliver a speech on the channel tunnel. He was the youngest person to address the Academy since Napoleon.

During this critical formative period, the Suez Canal Co., whose main property had been expropriated by President Nasser of Egypt only a few months earlier, entered into fruitful conversations with the officers and advisers of Technical Studies, Inc., whose Executive Vice-President, Cyril C. Means, Jr., flew to Paris and London to maintain the project's momentum. The conversations were rapidly widened to include the two companies whose predecessors-in-interest had begun to build a pilot tunnel in the 1880s (when British fear of a French "sneak attack" through the tunnel led to a withdrawal of the support of Her Majesty's Government—despite Queen Victoria's stated friendliness to the project "in the name of all the ladies of England").

A remarkably terse "Protocole d'Accord," signed in Paris on July 26, 1957, established the Channel Tunnel Study Group. For more than 15 years, during which about \$12 million was expended on almost every conceivable type of investigation into alternate forms of a cross-channel link, this document proved sufficient as a basis for the cooperation of organizations and individuals in a variety of official, quasi-public, and private positions. The Group proved cohesive and enduring enough to appoint a technical staff, to conduct negotiations with two of the leading powers of Europe, to assemble and manage a highly specialized fleet, to generate the confidence necessary for pledging vast sums of private capital, and to emerge with an honorable position in the ultimate project. At the beginning, Technical Studies had only a 10 per cent interest in the Group, but within a short time, with the adhesion of Morgan Stanley, Dillon Read and others, the Group emerged as an entity with four equal participants: The Suez Financial Co., Technical Studies, Inc., the Channel Tunnel Co., Ltd., and a French Group consisting of the venerable Société Concessionnaire du Chemin de Fer Sous-Marin Entre la France et l'Angleterre and the International Road Federation (Paris Office).

Interdisciplinary and Intersectoral

The Study Group was noteworthy in a number of respects. The decision to include the trucking and automobile interests (represented by the International Road Federation) made it possible for the dialogue between the traditionally antagonistic road and rail organizations to take place *within* the Group on a non-polemical basis, and with the assurance that the legitimate interests of both parties would be respected. Moreover, Monsieur Louis Armand added to the *European* character of the Protocole d'Accord by signing as Secretary-General of the International Union of Railways and not merely as Chairman of the French National Railways (S.N.C.F.) (The International Union of Railways includes British Railways and all the leading railway

systems of the Continent.)

The Study Group had, from the outset, an intersectoral character. Due to nationalization of the French railway system, half the shares of the Société Concessionnaire were owned by the S.N.C.F.; for similar reasons, the British Railways Board owned a significant interest in the Channel Tunnel Co., Ltd. And, due to Disraeli's famous 1875 *coup* in buying the shares of the Khedive of Egypt, Her Majesty's Government still controlled perhaps 30 per cent of the shares of the Suez Financial Co. Only Technical Studies, Inc., is entirely privately owned; but the American participant attracted to membership on its Board a number of persons with outstanding records of government service.

Emphasizing its intersectoral character and status, the Study Group promptly appointed as Co-Chairmen Ambassador René Massigli, until his retirement the Permanent Secretary-General of the Quai d'Orsay, and Sir Ivone Augustine Kirkpatrick, G.C.B., G.C.M.G., who had just retired as Permanent Under-Secretary of State at the Foreign Office. Monsieur Paul Leroy-Beaulieu, a former Inspecteur des Finances whose family had been interested in the tunnel project for nearly a century, was elected Chairman of the Steering Committee. On the Study Group's Supervisory Board, the British Group (25 per cent) was represented by Leo F. A. d'Erlanger, Alexander B. B. Valentine (later Sir Alec, who was a member of the British Railways Board and chairman of London Transport), and Ernest G. Whitaker of Unilever, President of the Institute of Transport, whose nomination had been suggested by the Confederation of British Industries. The French Group (25 per cent) was represented by the ebullient Chairman of the French National Railways (the late Louis Armand), by Jacques Getten of MM. de Rothschild Frères, and by Baron Charles de Wouters d'Oplinter (of Belgium), President of the International Road Federation (Paris Office).

The Compagnie Financière de Suez (25 per cent) was represented by its Director-General, Jacques-Georges Picot; by His Excellency, Charles Corbin, Ambassadeur de France, and by the Rt. Hon. the Viscount Harcourt, K.C.M.G., O.B.E., of Morgan Grenfell and Co. Technical Studies, Inc. (25 per cent), appointed as representatives its chairman, Monsieur de Vitry; Thomas S. Lamont, Vice-Chairman of J. P. Morgan and Co. (now Morgan Guaranty Trust Company of New York), and Alfred E. Davidson, who served for ten years as general counsel to the Study Group. Upon the death of Mr. Lamont, the Hon. Lewis W. Douglas, former United States Ambassador to the Court of St. James's, joined the Supervisory Board. At various times, George W. Ball (later United States Under Secretary of State and Ambassador to the United Nations), John Ferguson (later Ambassador to Morocco), and this writer served on the Board.

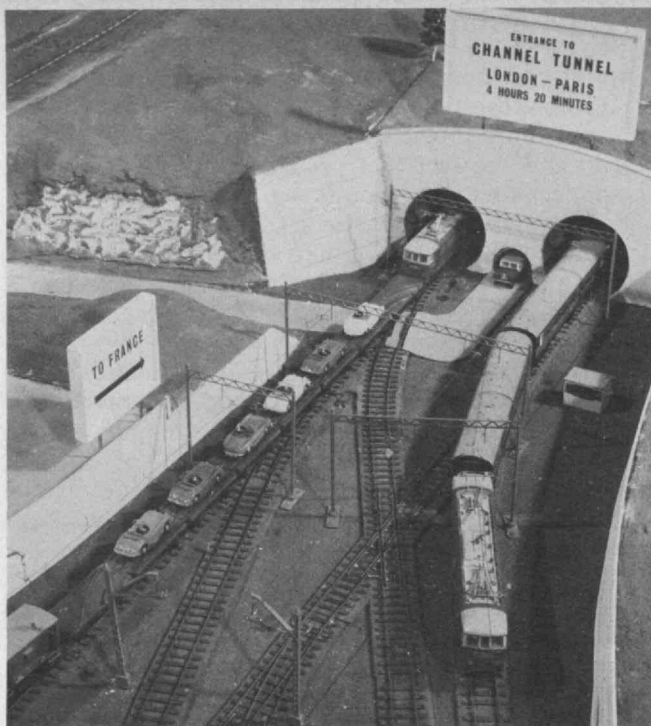
It is of interest that neither contractors nor consulting engineers were named to the management group; the old adage, "Experts on tap, not on top" was scrupulously observed. There was thus no taint of favoritism toward any industrial or advisory group. René Malcor, Ingénieur-en-Chef (later Ingénieur-Général) des Ponts et Chaussées was appointed Delegate of the Group and Chief Engineer. The Associate Chief Engineer, Harold Harding (now Sir Harold) was later President of the Institution of Civil Engineers in London. The exem-

plary teamwork of Monsieur Malcor and Mr. Harding effectively forestalled the emergence of parochial cliques based on narrow preferences. For example, Mr. Harding presented a clear analysis, "Channel Crossing Controversies—Review of a Variety of Schemes Submitted," in the November, 1961, issue of *The Dock and Harbour Authority*, to explain why the Channel Tunnel Study Group had recommended twin railway tunnels, bored or immersed, instead of the myriad alternatives such as a road tunnel, road-rail tunnel, bridge, bridge-tunnel, etc. In its report, published on March 28, 1960, the Study Group had offered to finance "a railway tunnel, bored or immersed, which would at the same time provide adequate and convenient transport facilities for cars, coaches, and lorries". It was suggested that the Tunnel be operated jointly by the British and French Railways "under a long lease from the Tunnel Company," and that an Intergovernmental Commission be appointed to discuss with the Group the detailed execution of the project.

Publication of this report was shortly followed by the constitution of a rival organization specifically to promote a bridge. Jules Moch, a former Minister of the Interior, spearheaded the campaign of a number of contractors and industrialists disappointed by the Study Group's finding that a bridge would be too costly and impractical from the viewpoints of navigation and international law. The resulting campaign to gather support for a channel bridge had overtones of the efforts of Schneider-Hersent in the 1890s for a similar purpose.

By the end of 1961 an intergovernmental "Working Group of British and French Officials" was appointed to review both the Channel Tunnel Study Group's 1960 Report and a proposal dated October, 1961, by the Channel Bridge Study Group. The decisive White Paper (Cmnd. 2137), entitled "Proposals for a Fixed Channel Link," published in September, 1963, came out unreservedly in favor of a tunnel. In the view of the Working Group, "The bridge . . . would undoubtedly be a new and serious hazard and source of delay to mercantile and naval shipping in the Straits of Dover, which is one of the busiest shipping channels in the world, with traffic of the order of 500 ships a day." There was a thoroughgoing review of financial, technical, and legal aspects; the net result was a decision by the two governments to advance to the Channel Tunnel Study Group the millions of dollars required for a detailed geological survey in the Straits of Dover.

In order to verify the continuity of the lower chalk,



A working model of a rail terminal to serve the English end of a Channel Tunnel built by the British Transport Commission shows the principal features simplified and reduced to be related to tunnel entrance; in reality the terminal, some three miles long, would be six miles from the portal.

a fleet of barges, oil-drilling platforms, World War II landing ships, and other craft was assembled in Dover Harbor. Seventy core borings were made at sea, and new methods—including undersea technology developed by Professor Harold E. Edgerton at M.I.T.—were used for a continuous profile of the subsea geology.

For a while, matters moved forward rapidly. General de Gaulle had always supported the idea of a tunnel, and a great many expectations were aroused when, on

The Channel Tunnel Study Group: a unique enterprise bringing governments, financiers, engineers—and even trucking, automotive, and railroad interests—together on an international basis

February 8, 1964, an exchange of messages was published between Her Majesty the Queen and the President of the French Republic hailing "the historical importance of the decision to build a Channel tunnel". However, a few details remained to be settled; when Britain's bid to join the Common Market was vetoed by General de Gaulle, the ensuing political coolness between the partners in the "Entente Cordiale" made it difficult to move decisively toward detailed agreement on the tunnel project. Nonetheless, slow but methodical progress was made in sorting out the difficult financial concepts and plans and in developing the final organizations to be entrusted with both finance and construction.

There was understandable concern about the security for the rather vast investment required. The lease arrangement proposed in 1960 would have obviated the need for government guarantees of the bonds, but in the end it was decided to rely mainly on government-guaranteed bonds (in addition to the risk capital to be raised in the form of equity shares). Mr. Wilson's Labour Government continued the momentum of the project on the British side; British and French ministries agreed on the formula of private finance and construction, with ownership to be entrusted to the two Governments after the date of "handover." A joint Channel Tunnel Authority would manage the facility on behalf of the two governments.

In 1964 the governments recommended that the Study Group's financial members add banks from two competing consortia, thus forming one enlarged group which would then negotiate with the British and French governments. Lengthy negotiations over the next few years resulted in the formation of a new "Group" consisting of the "British Sub-Group" and the "French Sub-Group" as follows:

British Sub-Group

Channel Tunnel Investments, Ltd.
The Rio Tinto Zinc Corp., Ltd.
Morgan Grenfell and Co., Ltd.
Robert Fleming and Co., Ltd.
Hill Samuel and Co., Ltd.
Kleinwort, Benson, Ltd.
S.G. Warburg and Co., Ltd.
The British Railways Board
Morgan Stanley and Co., Inc.
The First Boston Corp.
White, Weld and Co., Ltd.

French Sub-Group:

Banque Louis-Dreyfus
Banque Nationale de Paris
Banque de Paris et des Pays-Bas
Banque de l'Union Européenne
Compagnie Financière de Suez
Compagnie du Nord
Crédit Commercial de France
Crédit Lyonnais
Société Générale
Société Nationale des Chemins de Fer Français

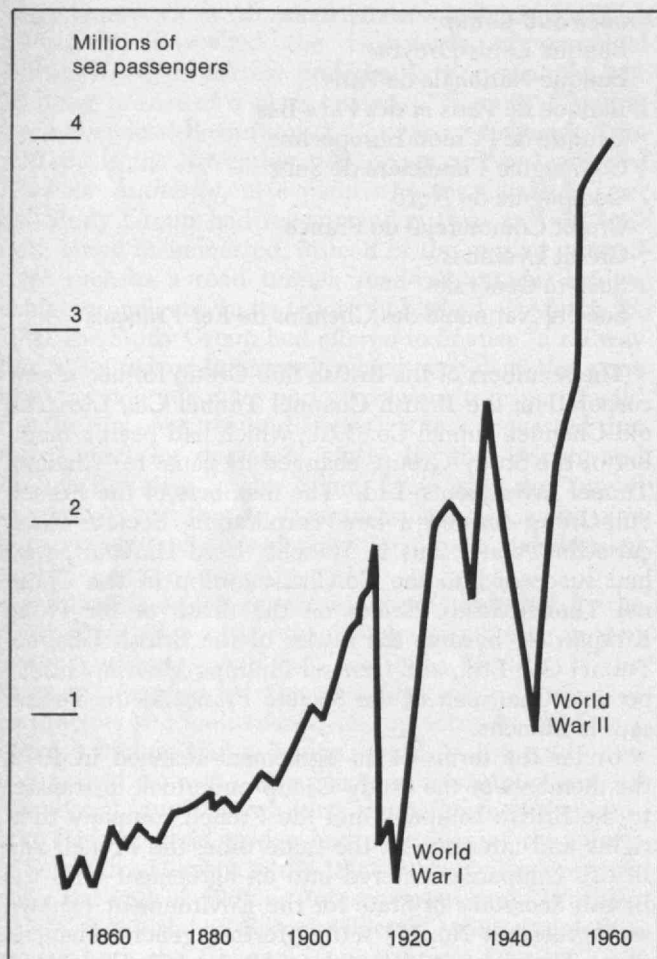
The members of the British Sub-Group formed a new corporation, the British Channel Tunnel Co., Ltd. The old Channel Tunnel Co., Ltd., which had been a member of the Study Group, changed its name to "Channel Tunnel Investments, Ltd." The members of the French Sub-Group formed a new corporation, Société Française du Tunnel sous la Manche. Lord Harcourt, who had succeeded to the Co-Chairmanship of the Channel Tunnel Study Group on the death of Sir Ivone Kirkpatrick, became the leader of the British Channel Tunnel Co., Ltd., and Général Philippe Maurin, C.B.E., became Chairman of the Société Française du Tunnel sous la Manche.

Under the terms of an agreement reached in 1972, the members of the Study Group undertook to transfer to the British company and the French company their rights and interests. At the same time, the French and British companies entered into an agreement with the British Secretary of State for the Environment (known as "Agreement No. 1") setting forth a general financial plan. The debt is planned to be amortized over 25 years. There is to be a public issue of risk capital in an amount equivalent to at least 10 per cent of the total estimated cost, of which at least 5 per cent shall consist of shares. The governments are to guarantee bonds in an amount up to 90 per cent of the cost.

A similar agreement was entered into between the French government and the companies.

In March, 1973, the Secretary of State for the Environment presented a paper to the British Parliament summarizing the facts to be considered in deciding whether or not to proceed further with the Channel Tunnel Project, and in September, 1973, an extensive White Paper was presented to Parliament stating the government's position in favor of proceeding with the construction of the Tunnel.

New Scientist for October 11, 1973, carried a lengthy



A tunnel under the English Channel has been a subject of speculation since 1751, when the Academy of Amiens, France, awarded a prize for such a plan. Growing travel between Europe and Britain since then has assured a continuation of the dialogue—and finally the authorization for the commencement of work on the project itself.

report and analysis of the environmental and other issues which were of interest; a principal fear expressed was that arrangements for "car-ferry" service on coast-to-coast shuttle trains would induce an over-use of Kent's already-congested highway network. But this matter seemed manageable, and on Tuesday, November 13, the Channel Tunnel (Initial Finance) Bill went through its final stages in the House of Lords and received the Royal Assent.

Design and performance characteristics were officially published in the schedules annexed to the Treaty: terminals to be built at Cheriton and Fréthun; the length of the tunnels to be 49 km.; the tunnels to be "suitable for trains travelling at speeds of 200 kilometers per hour." However, with the re-assessment of the project now being carried out by the government of Harold Wilson, there may be a reduction of the provision for piggybacked motor transport; concern for the environmental impacts on the southeast of England may bring about changes in the projected Kent terminal.

Travel time from London to Paris will be no more than three hours and forty minutes; with the expected new high-speed line to London and the coming of an advanced passenger train, the time could eventually be cut to three hours or less. The obvious advantages of avoiding loading and unloading of freight at both tunnel terminals leads to the prospect of an integrated rail network from London to Lille—or even to Berlin.

A Model for Macro-Engineering

The launching of the Channel Tunnel is likely to accelerate serious consideration of a host of other major infra-structure projects in Europe and elsewhere. The bridge across the Great Belt, to link the two parts of Denmark; the Italy-Sicily bridge across the Straits of Messina; a Gibraltar tunnel; a tunnel or bridge from the Canadian mainland to Prince Edward Island; a mechanical ship transport facility in Central America or Mexico and another across the Isthmus of Kra—all these and a host of other large projects can no longer be laughed away as "too expensive" or "too fanciful." The issue becomes rather one of values and trade-offs: to what extent is it useful to link up the world's land-masses? Shall we see a Russian-American study group on the future of the Bering Straits? Shall the United States eventually favor the preparation of a vast land-use plan, on the precedent of the Tanaka project for Japan, in order to limit the ravages of uncontrolled industrial and urban growth? Shall we decide to marshal the requisite resources to launch a palletized and automated transport system that can combine the economies of rail transport with the flexibility of roadways?

A few years ago, environmentalists would have been wellnigh unanimous in condemning all macro-projects as inevitably productive of economic and industrial growth and therefore of pollution. But today there is increasing interest in the concept of "trade-off" studies: if we are to be less dependent on the petrol-burning automobile, alternatives must be *engineered* and *marketed*. John Cummins' imaginative bill for a National Bikeway System will not be enacted without a large effort of education and its purpose will not be achieved without a considerable investment of money. But society without an efficient infra-structure is doomed to frustration; the task is to define purposes

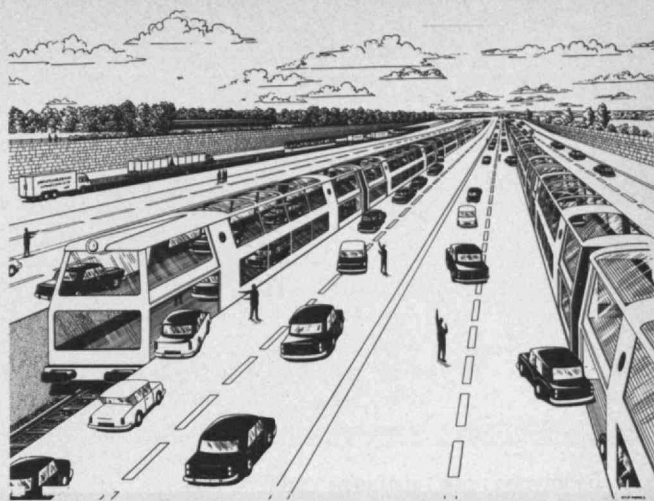
and preferences, and to rally support for those solutions which best accord with the long-term interest of the public.

In the United States, there are pressing needs for a more rational ordering of physical space and facilities. We should be building "energy parks" where proper safety measures can be assured for our growing numbers of nuclear power plants. Cities should be assisted in acquiring surrounding land that can be maintained as farmland or as forests for nature preserves or recreational areas. Financial talent must help devise incentives for a reasonably rapid establishment of an automobile industry based on power plants other than the conventional internal combustion engine.

For all such tasks, an "enlightened" public opinion is essential. But there is another and frequently overlooked requirement: the various individuals whose participation is necessary to a viable project must meet, talk, and study on a regular basis, without the constraints imposed by the nineteenth-century vocabulary of "public sector" and "private sector." The Channel Tunnel Study Group was no doubt a beneficiary of a change in Britain's traditional insular attitude; but even a "favorable atmosphere" does not create a live project in the real world; there must be skills of all kinds brought to bear with effort, patience, communication, cooperation, and good faith. I believe America could benefit from a modest proliferation of groups such as the Channel Tunnel Study Group to tackle specific tasks where engineering, legal, financial, environmental, and philosophical skills are required. If we are to move toward an equilibrium society there must be choices, understandable programs, and deliberate activity. A society where everything is allowed to run down would attract certain public indignation; the ensuing backlash could set back hopes for environmental improvement by decades.

It is perhaps symptomatic of our plight that the most "advanced" technical suggestions for rescuing our eastern railroads consist in proposals to imitate what the Japanese actually constructed more than 15 years ago! Indeed, it is against the background of our current dilemmas that I think the channel tunnel story deserves scrutiny. Innovative financial and legal thinking was, in this case, equally as important as engineering judgment. Fortunately, the bankers and international lawyers were present at the outset and were able to exchange views on an informal but regularly scheduled basis with their compeers in government. When the complete history of the project is written, a large measure of credit will be assigned to imaginative bankers such as Henry S. Morgan, Frederic Brandi, Thomas Lamont, Jean Cattier, and John F. Fowler, Jr. (in the United States) and to Leo d'Erlanger, William Merton, Lord Harcourt, the Baron Guy de Rothschild and others in England and France.

On the engineering side, the United States contribution was not negligible. The bored tunnel consortium, which included Bechtel Corp., Brown and Root, Inc. and the Morrison-Knudsen Co., Inc., volunteered a report which established a baseline for subsequent studies; the late Charles Dunn, who supervised the research and design, was at the time the world's most experienced tunnel engineer. American companies were also active in the immersed tube consortium; Raymond International, Inc., Kaiser Engineers, Peter Kiewit, De



Highway, railway, or dual-mode tunnels? The question, hotly debated, is now resolved in favor of railroad tunnels. Freight and passenger equipment will run between Britain and France without barge trans-shipment between origin and destination; automobiles and their passengers may be handled in special equipment on shuttle trains.

Long and other firms, marshalled by the late George M. Ferris, were able to design a believable project for a cross-channel tube to be laid in a dredged trench. The Chief Engineer of the Port of New York Authority, the late John M. Kyle, Jr., was frequently and usefully consulted. W. O. Smith of the United States Geological Survey gave helpful advice on the planning of the sub-sea survey in the Straits of Dover; his participation required a Presidential finding that the tunnel was in furtherance of the purposes of the Mutual Security Act; as a result the United States government was several years in advance of either the British or the French government in conferring an official blessing on the project, at the highest level!

Further Readings and References

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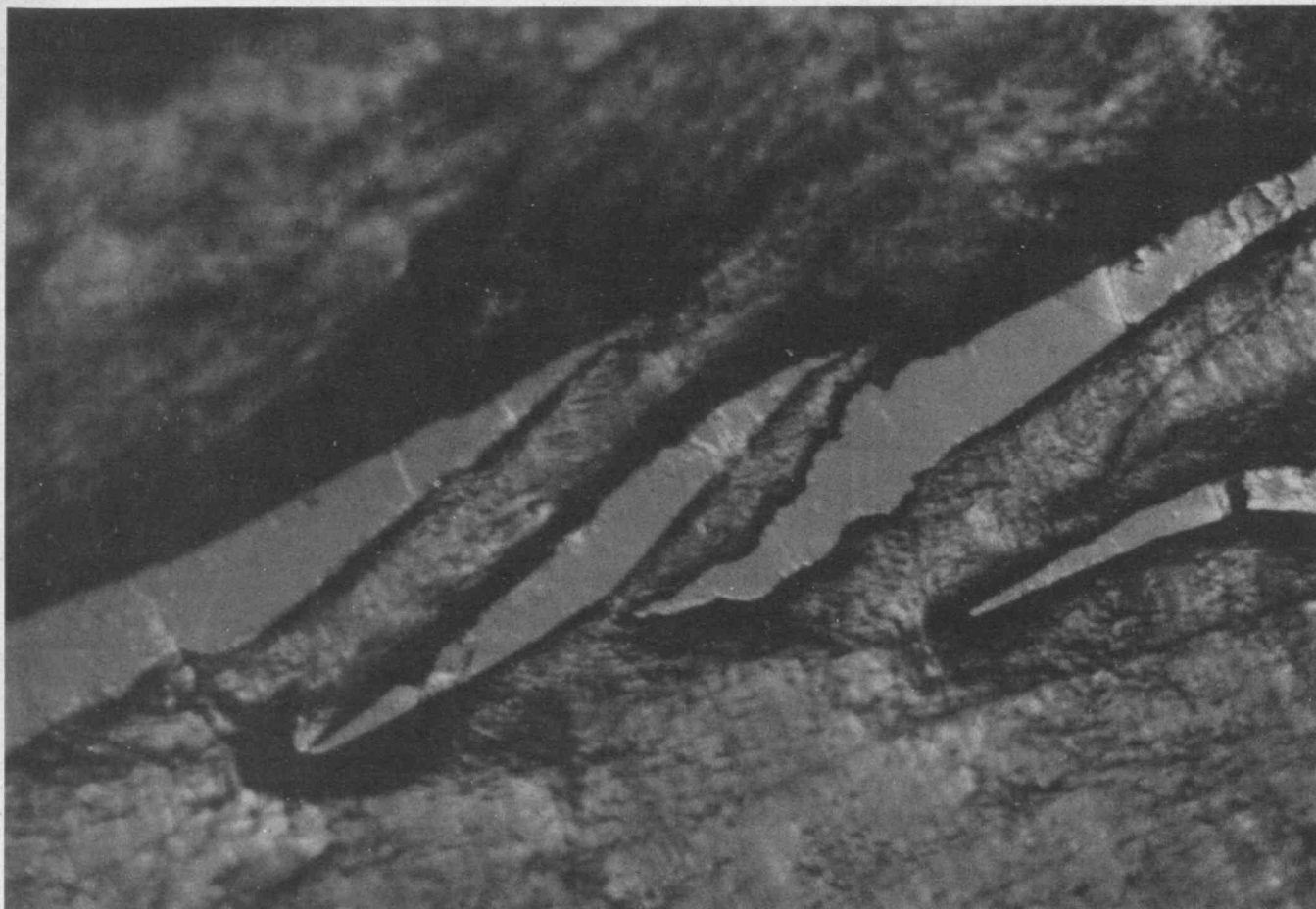
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Frank P. Davidson, J.D., is Senior Research Associate and Chairman of the System Dynamics Steering Committee at M.I.T. A founder of the Channel Tunnel Study Group, he has served for 17 years as President of Technical Studies, Inc., the Group's United States participant. Mr. Davidson is widely known as an adviser to public interest groups, corporations, and governments for the assessment and planning of projects of unusual magnitude or complexity. He initiated courses at M.I.T. on macro-engineering, institutional assessment, and the failure of human systems.



Touching its container only along a few ridges, this Skylab-grown crystal of indium antimonide grew essentially free-floating in space. It is the first such free-floating crystal ever grown.

Trends This Month

SPACE

Skylab crystals could lead to space factories . . . A very good time to be an astronomer . . . and even Kahoutek wasn't so bad.

ECOSYSTEMS

How much rain on the plain? . . . and how much dust in Antarctica?

EDUCATION

The new new math is real math.

BODY AND MIND

Is organic food better? . . . Maybe, but even primitive tribes have their problems . . . What happens when frostbite unfreezes? . . . Mind over gray matter.

TRANSPORTATION

Small change on energy savings.

SPACE

Superior Crystals Grown in Space

Earthlings have never been able to achieve the ultimate qualities possible in their materials because of the limitations imposed upon them by their planet. Steels are only about a tenth as strong as theory predicts, blades of jet engines do not function at temperatures where they potentially could and where efficiency would be much higher; and wires of heart pacemakers or bone prosthetics fail much sooner than they should.

A principal reason for such relative mediocrity is the ubiquitous force of gravity on earth. Gravity creates convection in solidifying materials which compromise their perfection and mask other effects which might be reduced if fully understood.

Hence scientists' continuing interest in gravity-free outer space as a unique environment in which to produce higher-quality materials and—even more important—in which to study fundamentals of material processing.

Skylab provided the first outer-space laboratory for such experiments, and the first reports of work on Skylab III, given this winter at the annual meeting of the American Association for the Advancement of Science, confirm the importance of outer space for materials processing.

Five scientists from M.I.T.'s Center for Materials Science and Engineering, reporting the results of partial melting and regrowing three crystals of the semiconductor indium antimonide on Skylab III, said that gravity-induced convection effects were absent. And surface "wrinkles" on the crystals, caused by tension differences over the solidifying crystal's surface, remained on the surface and did not produce imperfections deep within the crystal. Scientists had feared that surface tension-produced convection might be "unleashed" without gravity.

The scientists are convinced that their results confirm the value of materials experiments in space.

The M.I.T. Skylab III experiment, reported to the A.A.A.S. in a paper by Professors Harry C. Gatos and August F. Witt, Clifford J. Herman, Engineering assistant, and Mary C. Lavine and Manfred Lichtensteiger of the M.I.T. research staff, consisted of partially melting and then regrowing three rod-shaped indium antimonide crystals; one was pure, one was "doped" with tellurium, and one was "doped" with tin. ("Doping" is the process of adding a measured amount of a chemical element to give a crystal special electrical properties. Controlling the uniformity of "doping" material throughout the crystals is almost impossible because of gravity-induced convection.)

The first results reported to the A.A.A.S. focussed on the tellurium-doped crystal. For reasons "not yet in the book," this crystal on board Skylab grew virtually without contacting the wall of its quartz container, except along a few ridges. The behavior was "totally unexpected"—different from the other two crystals, from any other crystals grown in space, and from any crystals even grown on earth," concluded the scientists. "This crystal grew as though it were essentially uncontained after melting, allowing us to see the effects of free surface convection on gravity-free crystallization," said the scientists.

Because gravity-induced convection was absent, the crystals also revealed new crystallization phenomena which the M.I.T. group believes may show the way to new basic research in materials science. "The uniqueness of outer space for processing materials and for establishing fundamental facts of solidification and segregation phenomena was unambiguously demonstrated," they declared.

Analysis of the Skylab III crystals is continuing; meanwhile, a second set of crystals, yet to be examined, were grown by the Skylab IV astronauts.

Professors Gatos and Witt and their

associates have designed a more refined experiment to be carried out aboard the joint Soviet-American space mission in 1975; but beyond this experiment their next opportunity in space will probably not be until the institution of the U.S. space shuttle program in the early 1980s.

Other Skylab III materials processing experiments were reported at the A.A.A.S. meeting by scientists from the University of California (Los Angeles) and Rensselaer Polytechnic Institute. Both these experiments, like the M.I.T. studies, achieved results unobtainable on earth; Heribert Wiedemeier, Professor of Physical Chemistry at Rensselaer, believed his results on mass transfer rates in crystals grown in the gravity-free environment demonstrated a "technique which is of technological significance."—*Dennis Meredith*

The Best Time To Be Alive

In all the history of the world, mankind's knowledge has never been multiplying faster. Less than 30 days ago there suddenly were 2,000 new photographs of Mercury made at distances ranging from 1,000 to 100 km.—a planet never before seen except through earthbound telescopes. Some 60 days ago Professor Bruce Murray of California Institute of Technology was proudly showing his colleagues at the American Association for the Advancement of Science his first, primitive, time-lapse-like photographs of the murky atmosphere of Venus. Carl Sagan, Professor of Astronomy at Cornell, is speculating on the existence of clouds—and hence on atmosphere—on an obscure little moon orbiting Saturn, the distant planet whose ring excites the curiosity of every amateur and professional astronomer.

For astronomers it is a decade of immense excitement, "a unique time" to be savored humbly and with thanksgiving; "that we have been chosen to do this exploration is almost an accident. . . a striking mixture of human and celestial mechanics. . . what a privilege to be part of it!" said Professor Murray.

"The curve of new knowledge will never be steeper," said Professor Sagan. "The best time to be alive is when you start out wondering and end up knowing," he said, "and that's us!"

Here are a few highlights of the reports which stimulated this outburst of philosophy from some of the country's leading astronomers at the A.A.A.S. meeting this winter.

—The first photographs by Mariner 10 leave Professor Murray breathless;

when you are seeing a planet for the first time it is understandably hard to be sure what is being seen. But he is convinced that Venus is covered by an "enormously thick and hot atmosphere" in which there are persistent layers but no well defined connection. Professor Murray imagines that penetrating this mantle—whatever it is—might be "like snorkeling in listless, muddy water." The layers imply that the material is a condensate, differentiated by density; and it seems to be drifting in parallel with Venus' equator. There are a permanent bright zone around the polar area, and an interaction—completely unexpected—between this sub-polar convection zone and the general turgid atmospheric circulation. Already, said Professor Murray, Mariner 10's is "a richer harvest than anyone expected," and he warned his audience against even his own interpretation of the data; when you find facts you didn't expect, the human mind is the slowest link on the path to understanding.

—Ever since he discovered the belts of ionized particles surrounding Earth, James A. van Allen of the University of Iowa has been waiting to find another planet with an electromagnetic environment like ours. He found it when Pioneer 10 passed Jupiter in December. But the mechanism on Jupiter—a cold, gaseous planet—can hardly be the same as that of Earth, with a core of molten iron. In Jupiter's case Dr. van Allen postulates a core of solid hydrogen under extreme pressure, the resulting magnetic influence of Jupiter extending millions of miles into space—"an enormous feature."

—Titan, the largest satellite of Saturn, has suddenly emerged as a place of great astronomical interest. It is the size of Mercury and the color—red—of Mars, and it is known to have an atmosphere—methane and hydrogen?—whose pressure exceeds that of Mars. If this "massive" atmosphere of methane and hydrogen exists so deep in the solar system, that alone is grounds for what Professor Sagan calls "the Titanian astonishment." But radiant energy supplied to methane and hydrogen will form a range of hydrocarbons, and Professor Sagan is convinced: "There is no getting away in any model from organic materials in quantities on Titan."

—The more we learn of Mars, the more we sense the importance of its atmospheric properties and processes in the sculpturing as well as in the chemistry of its surface. "It's hard to escape the conclusion, said Professor Sagan "that meteorology is about to be tested on new ground, a substantial extension of its demands and power." —What about life, such as that on

Earth, on some other planet in our galaxy? We see proceeding elsewhere in the universe the processes of gas and dust coalescing into stars—the processes from which we are certain grew our sun and solar system. There is nothing to discourage us from assuming that every single star thus formed will have accompanying it a solar system such as ours, said Professor A. G. W. Cameron of the Harvard College Observatory, and this is a concept that "allows for the existence of huge numbers of intelligent races of beings," he said.

Frank Drake, Professor of Astronomy at Cornell, went one step further: if our understanding of the process of star formation within our own galaxy is correct, "we can say that new systems of living things are being produced in our galaxy at the rate of one per year." How many of these give rise to technical civilizations? All we can say is that intelligence everywhere increases in evolution. We cannot imagine a solar system composed of bodies other than spheres, and this fundamental shape implies a planet with limited surface area, to exploit which will require intelligence and strength of numbers. Thus Professor Drake concludes, "technology is inevitable, everywhere in space; the value of the gravitational constant tends irrevocably toward specialization and manipulation of the environment" by living things wherever they may be.—*J.M.*

Kohoutek: More than Met the Naked Eye

The only fizzle associated with the Comet Kohoutek was its failure to light up the new year's sky. Scientifically, it was spectacular. Its coming was probably the most intensively observed celestial event ever, for its discoverer Lubos Kohoutek gave scientists nine months to prepare.

On its emergence from perihelion on December 29, Skylab scientists saw it shoot out a sunward spike, the first observation of this kind. Japanese astrophysicist Z. Sekanina suggests that the "anti-tail" was partly caused by a large number of millimeter-size dust particles near the head.

The normal tail stretching away from the sun contained gas and dust, the dust extending only halfway along its 17-degree length. On January 16, the tail underwent a waving motion 10 or so degrees from the head.

More than 200 previously unknown emission lines were recorded by the spectroscope at the Hale Observatory. Optical and radio astronomers also detected emissions from cyanogen, carbon monoxide, sodium, methyl cyanide, hy-

drogen cyanide, carbon molecules containing two and three atoms, and the free radicals $\text{OH}\cdot$, $\text{CH}\cdot$, and $\text{CH}_2\cdot$.

The tail was reported to have a silicate structure, while the spike displayed black body radiation, supporting Dr. Sekanina's dust hypothesis.

These early findings from the world's observers, plus detection of a hydrogen halo around the head, lead to the exciting possibility of interstellar origin of comets.—R.S.

ECOSYSTEMS

Mapping Rain

Between 4 p.m. and midnight on October 10, 1973, a weather front advancing across the southwest brought 17 inches of rain to Enid, Oklahoma. In the process it provided the best laboratory yet for a program to coordinate data from rainfall gauges, radar, and satellites into a single, comprehensive understanding of storm behavior which is underway at N.O.A.A.'s National Severe Storms Laboratory in Norman, Oklahoma.

No one way of quantifying a rainstorm is really adequate. Rain gauges measure only the accumulation at their particular locations, and even those data are likely to be biased by wind and terrain features. Radar can give a comprehensive overview of a storm and its organization, but actual amounts of rainfall at various points in the storm are hard to infer. Satellite pictures show storm organization and large-scale features, but clouds as seen from above do not correlate well with rainfall or even with details of structure.

All three forms of data were brought together by Edwin Kessler (M.I.T. Sc.D.'57) and Kenneth E. Wilk of N.S.S.L. Rain gauge data provided a calibration for the radar-based information; it turned out the radar data was to be multiplied by 2.4 to agree with rain gauge readings. This combination of the two data sets resulted in a precipitation map which is "superior to either data set considered alone," Messrs. Kessler and Wilk told the American Association for the Advancement of Science this winter. Their results confirm the usefulness of computer-based techniques for combining radar and rain gauge data devised by Edward A. Brandes of N.S.S.L.

The combination, they say, "preserves the spatial detail of the radar data and uses the relatively more accurate point measurements of the rain gauges to give detailed area-depth data previously unattainable." They think the system will work even better in the future as the meteorologists learn more about correlating data between the systems, especially including satellite pictures.—J.M.

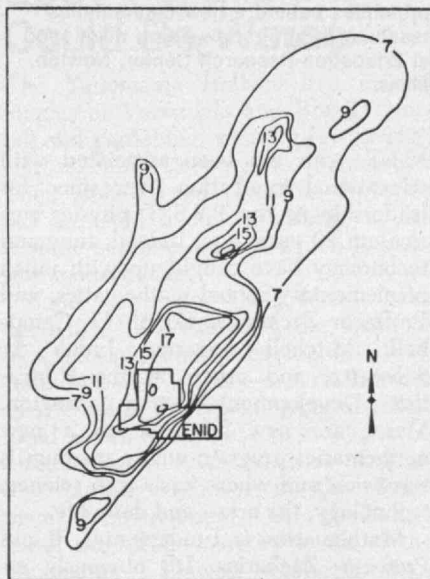
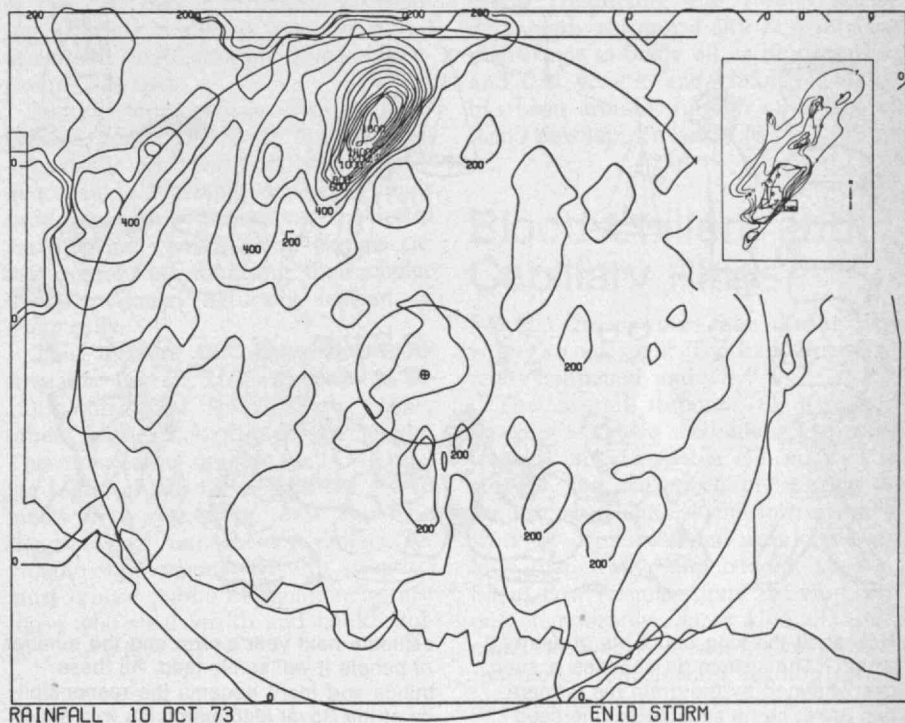
Dust in Antarctic Air

There should be no better place than the South Pole to measure what is naturally in the atmosphere—in contrast to what man puts in from his chimneys and exhaust pipes. Reasoning thus, three chemists—all graduates of M.I.T.—have made the measurement, and they have identified five elements present in the cold, clear air of Antarctica in concentrations larger than they can understand.

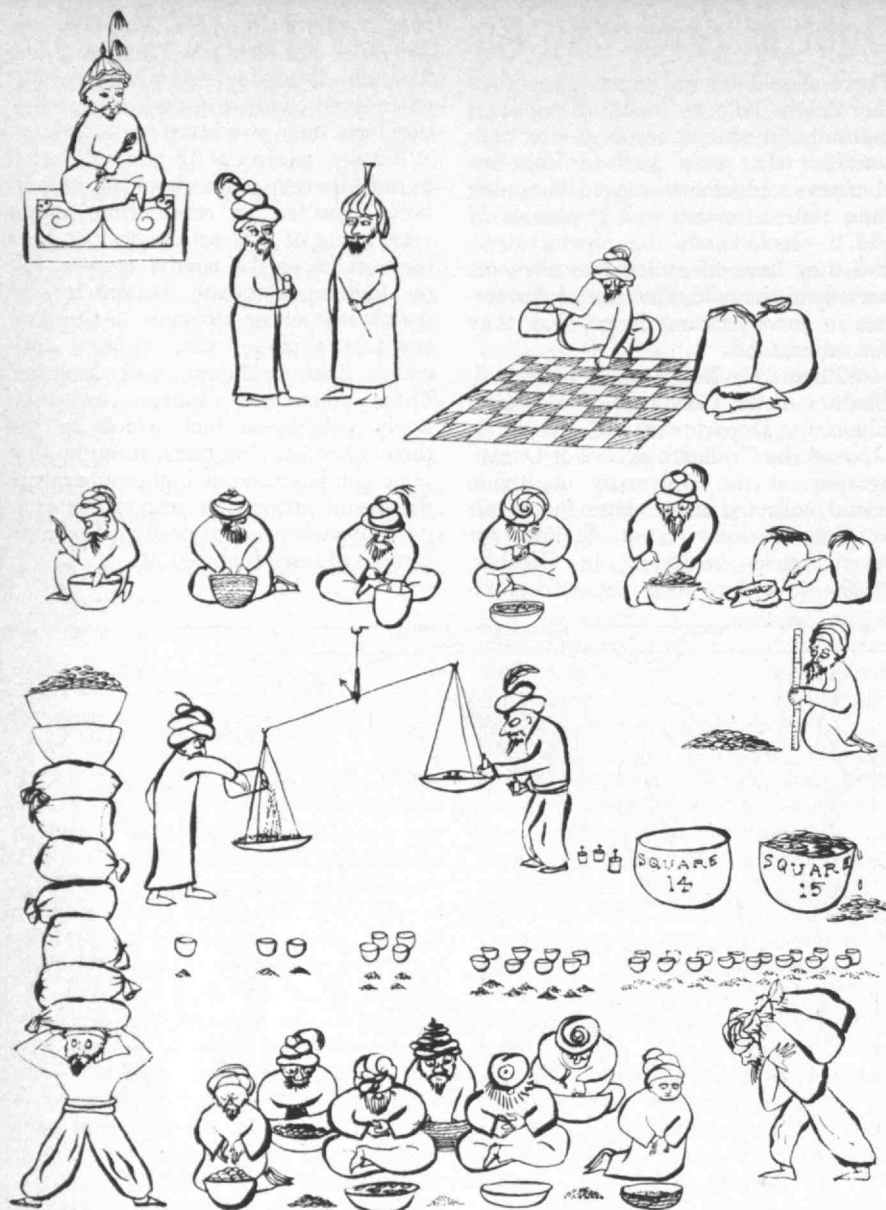
William H. Zoller and Ernest S. Gladney of the University of Maryland Chemistry Department and Robert A. Duce of the Graduate School of Oceanography at the University of Rhode Island collected particulates in the air at the Amundsen-Scott Station for seven weeks beginning in October, 1970. Now they have reported (*Sci-*

ence, January 18, 1974, Vol. 183, pp. 198-200) the contents of their filters for ten three-day sampling periods when wind conditions made contamination from their own camp impossible.

Results: a series of 15 minerals found in the Antarctic air in about the proportions expected to result from either weathering of the earth's crust or from the surface of the nearby oceans. But no similar process can account for the enrichment of six elements in the Antarctic atmosphere: zinc, copper, antimony, lead, selenium, and bromine. These anomalous elements are relatively volatile—a fact which to the three chemists "suggests strongly that some condensation or high-temperature dispersion process" is responsible . . . perhaps volcanism, or perhaps the combustion of fossil fuels.—J.M.



The map at the left, drawn from readings obtained in a special storm survey by staff of the National Weather Service, shows the "isohyetal pattern"—a rainfall "contour map"—for an intense storm which dropped up to 17 in. of precipitation on Enid, Okla., on October 10, 1973. The area map above was drawn from radar and rain-gauge data according to a computer program devised at the National Severe Storms Laboratory in Norman, Okla. The general agreement of the two for the Enid area speak to the success of the computer program; but the variations in radar calibration factor reveal important work remaining to be done, Edwin Kessler and Kenneth E. Wilk of N.S.S.L. told the American Association for the Advancement of Science this winter.



How shall the king count his grains of wheat? The system he chooses is soon overwhelmed by the grain his farmers can grow: so he substitutes one seed for 100 grains. That turns out to be too tedious; hence the concept of estimation. Then he loans grain to a neighbor (debt is "the earliest of negative quantities"), and presently there is need to

estimate next year's crop and the number of people it will safely feed. All these things and more become the responsibility of the Royal Mathematician in a simple tale which illustrates many of the principles behind a new mathematics teaching program now being developed at Education Research Center, Newton, Mass.

EDUCATION

Can Mathematics Really Be Real?

"A freight train leaves Albany for New York at 6 o'clock. An express train leaves on the same track at 8 o'clock; it goes at the rate of 40 m.p.h. At what time will it overtake the freight train if the latter stops after it has gone 56 miles?"

So what's the matter with that?

A good deal, thinks Jerold R. Zacharias, Institute Professor, Emeritus, at

M.I.T. who has been associated with educational innovation ever since his leadership of the P.S.S.C. physics curriculum 20 years ago. Indeed, time and technology have caught up with much of elementary school mathematics, and Professor Zacharias, Edwin D. Campbell, Mitchell Lazarus, Judah L. Schwartz, and others at the Education Development Center, Newton, Mass., are now at work on a new mathematics program whose medium is television and whose basis is in science, technology, the arts—and daily life.

Mathematics is fundamental, thinks Professor Zacharias. It's obviously es-

sential in daily life to almost every citizen, and a lack of skill with mathematics can "profoundly affect the course of a person's life, by closing off any hope of professional training." Yet much of American children's first exposure to mathematics seems to Professor Zacharias and his colleagues to be antiquated, and a survey by the International Project for the Evaluation of Educational Achievement shows that American children fall far short of those in the rest of the industrialized world in mathematics achievement.

Four problems need correction: countless examples and exercises in addition, subtraction, multiplication, and division are simply boring; mathematics is presented as a world apart, unrelated to children's typical concerns; mathematics as now taught is sequential: you have to understand one item in order to proceed to the next, and if you stumble a little you're out; and mathematics is often taught with too little reference to its present or ultimate usefulness to the student.

Changes already needed are now made more urgent by changes in the way adults use mathematics: adding machines and cash registers are proliferating, and "computational dexterity" is plainly not as important as it used to be.

To correct some of these deficiencies, Professor Zacharias and his colleagues are now hard at work on a new television-based mathematics program for 8-to-11-year-olds in elementary schools; its objectives for its students are understandings of:

—Counting and ordering, including decimals and powers of ten.

—The concept of measurement—"the description of real objects and situations in numbers."

—Estimates and how they are made ("essential to a casual, intuitive use of mathematics").

—Scaling and mapping, and the underlying concept of ratio. ("If the relationship between a map and its subject is understood, then the relationship between mathematics and reality should be easier to teach.")

—One- and two-dimensional graphs.

These are the topics that are "most important to someone applying mathematics to real situations," propose the E.D.C. group. And they are to be dealt with in terms, units, and situations "typical of the sources of numbers in real life"—clocks and calendars, thermometers, measuring cups, speedometers, catalogs and timetables, supermarket register tapes.

"A simple measurement can carry one a long way into mathematics," thinks Professor Zacharias. And "it is no coincidence that adding up three 4's gives the same answer as adding up four 3's, and children should under-

stand why it is necessarily true." Robert Reinhold of the *New York Times* discovered the wisdom of this idea when he visited the E.D.C. project this spring: an 8-year-old was asked to give half his play money to his neighbor. "Quick as a flash," wrote Mr. Reinhold, "he handed over \$77.50. I took half of the hundred, then half of the \$50, and then half of the \$5," he explained . . . demonstrating an extraordinarily sophisticated knack of converting a difficult mathematical problem into a simpler one."—J.M.

BODY AND MIND

Chemicals on the Menu?

Rats fed nothing but spinach will die, as will rats fed nothing but white bread. The unlucky rats supply the attackers and the defenders of the organic food myth with one point of agreement—things should be taken in moderation. Deciding on which side the moderation should originate is yet another story.

Organic food is grown without the use of chemical fertilizers or pesticides. Taken in the broader sense, it is food the way the plant or animal grew it—not treated with preservatives, colorings, flavorings, or other chemicals. Claims are made for its life- and health-giving properties, most of which, according to the organic food panel at the American Association for the Advancement of Science this spring, are bunk.

Plants absorb nutrients from the soil only in an inorganic form, and "cannot tell whether chemicals are prepared in factories or come from natural sources," said Stephen Barrett of the Pennsylvania Medical Society. We are seeing the revival of the humus myth of plant nutrition, and disregarding the "momentous discoveries of the last 200 years," according to Daniel Arnon of the University of California at Berkeley. While natural fertilizers—manures and composts—have beneficial effects on the physical condition and water retention of the soil, they do not supply the variety of nutrients of chemical fertilizer. "If the organic soil is deficient in some essential element, the plant may reflect the deficiency and be less nutritious than food from plants grown on well-fortified inorganic soils," stated Don Paarlberg of the U.S. Department of Agriculture.

Pesticides? "While it would be marvelous if we could produce our foods without the use of any pesticides, the facts are that we have not been able to do so and will not be able to for a long time, if ever," according to Emil M. Mrak, member of the Califor-

nia Board of Agriculture. He admitted that pesticides have been misused, but thought this an indication that the pest management process should be guided by trained personnel, not abandoned.

The issue of food additives is more emotionally charged. While Dr. Mrak put the per capita per year consumption of the more than 1800 food additives at a pound, other sources claim five times that, and at least 674 of the additives on the GRAS list in 1960 are no longer "generally regarded as safe." And the per capita consumption of sugar, the most common additive and the bane of dentists and cardiologists, is 102 pounds per year. Organic nutritionists argue that ingestion of these additives can be harmful, and Dr. Mrak skirted the issue. "There is no chemical present anywhere in our environment and especially any natural component of our diet that is incapable of yielding alarming results in some biological system at high enough levels of exposure," he said.

Natural foods contain their share of poisons, added Dr. Mrak. Spinach contains oxalic acid, and lima beans hydrogen cyanide. Naturally occurring molds produce toxins containing powerful carcinogens. Natural food enthusiasts may merely be exercising their choice to be poisoned naturally instead of chemically.

This element of choice drew fire from Dr. Barrett. He criticized the organic nutritionist, Adelle Davis, among others, for her lack of scientific thought. Those preferring organic foods are paying higher prices for organically grown meats and vegetables, and spending thousands of unnecessary dollars for vitamin supplements. "Health scientists must arouse public indignation against those who steal health and health dollars," he said.—S.J.N.

Body Pollution: It Could Be Worse

The Yanomama Indians live in the jungles of Venezuela and Brazil, hunting and gardening, wearing few, if any, clothes, and sleeping in hammocks. Their isolated and primitive life style has attracted scientists wishing to determine baselines against which to measure modern man.

Some surprising discoveries have been made. As expected, the levels of hypertension, and trace metals—lead, cadmium, and copper—are much lower than those of the typical urban dweller. Lead levels, in fact, are so low as to be unaccountable by the absence of gasoline burning vehicles in the Yanomama's environment. On the other hand, the serum mercury levels of the Yanomama showed concentrations

equalling or exceeding those found in the Ann Arbor, Michigan control group. In some cases the levels were as high as those found in urban workers with chronic exposure to the metal.

Chromosome damage, too, is higher than was expected. While much of the damage was minor, researchers reported in the *Human Adaptability Newsletter* that in a few cases the aberrations exceeded the damage observed in the most heavily irradiated survivors of Hiroshima and Nagasaki and were some of the most abnormal ever found. The cause of the abnormalities is hypothesized to be some natural agent such as a virus, rather than nutritional deficiencies or radiation.

According to James V. Neel of the University of Michigan and head of the International Biological Program group conducting the studies, these data imply the possibility that modern man is not as badly off as he supposes, and that genetic and biologic damage has been around through all stages of man's development.—S.J.N.

Blood-Chillers and Capillary Plugs

So you froze your toes during last winter's cold spell? Too bad. But what really happened, and why?

The overall response of tissue to freezing is known well enough to make freezing an acceptable clinical tool in surgery. But the effects of freezing on the microcirculation—the intricate network of capillaries and arterioles—are less than fully understood. Clearly, blood flow resumes upon thawing, but only temporarily. Some kind of after-effect soon acts to once again prevent the blood from flowing, leading to the infection or death of the tissue.

A team of engineers and physicians from M.I.T.'s Cryogenic Engineering Laboratory and Massachusetts General Hospital are trying to find out why by watching the freezing and thawing process, experimentally induced in a small (about 1 cm. in diameter) section of a hamster's cheek pouch, through a "cryo-microscope"—a sophisticated temperature-controlled box in the field of a microscope equipped for producing still and motion pictures and closed-circuit television.

Sure enough, when the box is cooled so that the hamster tissue nears the freezing point, the blood flow slows. The higher the rate of cooling, the longer the low temperature exposure required to slow the flow of blood. But finally—always within 15 seconds of reaching 0°C.—all of the microcirculation ceased, and the microscope revealed a wave of darkening ice crys-

tals spreading through the vessels.

Immediately upon thawing, the blood in the vessels turned from dark red to light pink—apparently a homogeneous, unmoving mass. Fresh blood soon flushed out the pink material, but the new blood flow contained tiny, clear particles—emboli—believed to be aggregates of platelets, one of the elements of the blood involved in blood clotting. Like log jams, they adhered to the walls, were dislodged by the flow of blood and coasted on, adhered again, and then coasted out of view. Sometimes the emboli jammed together to completely stop the blood flow, either temporarily until pressure broke up the jam, or permanently.

Without exception, blood flow in the frozen area halted within a period of minutes after thawing. Sometimes this was the result of obstruction by emboli, sometimes it apparently was not. Always it was associated with the appearance of blood with brighter red coloring, and the flow always was stopped first in small vessels 15 to 30 microns in diameter, from which it spread to larger vessels in the microcirculation.

The team suspects that the changes in blood circulation which result from freezing may be the result of changes in the microcirculation vessels, causing vessel walls to accumulate blood elements in the form of emboli which—when big enough—are swept into the blood stream. The emboli later tend to readhere to the vessel walls at only certain points, where other emboli have broken away and where vessel surface characteristics have in fact been changed by the freezing process.

In their report to the American Society of Mechanical Engineers, the workers describe the response of the microcirculation as "a complex interaction between elements of the vascular network and elements of the blood." Work to clarify this interaction is continuing.

The project is sponsored in part by the National Heart and Lung Institute; the A.S.M.E. paper was by M. A. Hlatky, Professor Ernest G. Cravalho, and K. R. Diller of the M.I.T. Department of Mechanical Engineering and Dr. C. E. Huggins, Chief of the Surgical Low Temperature Unit at Massachusetts General Hospital. Huggins is also Associate Professor of Surgery at Harvard Medical School.—J.M.

More Consciousness On Consciousness

While scientists will seldom go further than conceding that there may be evidence for parapsychological phenomena, never mentioning "psychics"

without quotation marks, changes may be on the horizon.

The either you-believe-it-or-you-don't syndrome is being replaced by a need to understand, says Philip Lee of the University of California School of Medicine at San Francisco.

Robert Ornstein, also of the U.C. School of Medicine, has used alpha wave measurements—along with EEGs and other tests—to demonstrate that the two halves of the brain have separate functions. The left half is activated when the subject involves language and reasoning activity—arithmetic or letter-writing, for example. Visual or sensory input stimulates the right half, as does meditation, whose physical effects are comparable to a state of complete relaxation.

The separate halves of the brain are either active or idling, depending on the activity of the person. Since conscious thinking and learning processes—generally conceived of as "the mind"—take place in the left half, it is not surprising that increased activity in the right half, such as meditation, should produce an altered state of awareness. "This is no new electric phrenology," says colleague David Galin. "It demonstrates that the brain is merely specialized for different kinds of processing."

Taking matters a step further, Charles T. Tart, Professor of Psychology at the University of California (Davis), who joined the others at a panel before the American Association for the Advancement of Science in San Francisco this winter, presented a systems approach to altered states of consciousness. In his model the brain has a large number of capabilities—too many to use all at once. A cultural screening process selects and develops a small number of these potentialities, actively rejects others, and keeps us ignorant of most. Our awareness taken as a whole, labelled "discrete state of consciousness" by Dr. Tart, is a function of habit, and thus can be altered.

An important consequence of this theory would be the development of "state specific" sciences. "Our sciences have been very successful in dealing with the physical world, but not very successful in dealing with human, psychological problems. If we applied scientific method to developing sciences within various discrete states of consciousness, we would have sciences based on radically different perceptions, logics, communications, and so gain new views complementary to our current ones," said Dr. Tart.

But since any state of consciousness is only a limited construction, Dr. Tart emphasized that no one state can offer everything—and to optimize the benefits from their use, altered states of consciousness must remain in the do-

main of science.

Perhaps the most significant indication of progress in the field was that this information was all presented at the annual meeting of the American Association for the Advancement of Science this spring. Dr. Lee saw it as the beginning of a gradual acceptance of some very old ideas. "Science and mysticism may not be conflicting" after all.—S.J.N.

TRANSPORTATION

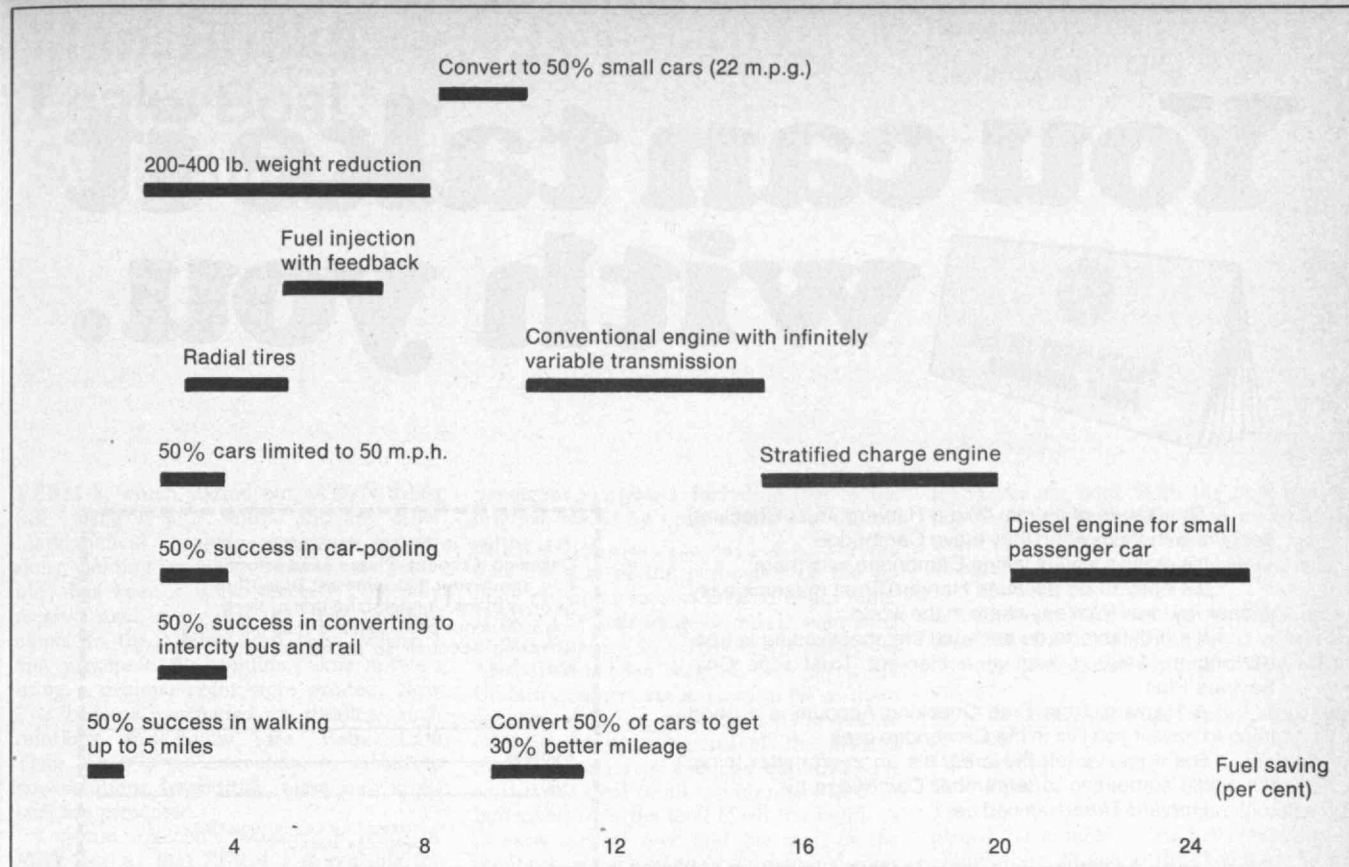
Conserving Transport Energy: Pennies and Nickels

We are told that when it comes to saving gasoline, every little bit helps. But when some seemingly logical proposals to do so are scrutinized, the savings amount to pennies, nickels, and dimes.

For instance, why not walk or bicycle to work or to the commuter station to save gasoline? What about converting 50 per cent of the passenger cars in the country to 22 m.p.g. small cars? Suppose 50 per cent of the urban commuters joined car pools? Or even suppose modified internal combustion engines ran on liquid hydrogen fuel?

These are all potential energy-saving alternatives, the practicality of which A. C. Malliaris and R. L. Strombotne of the Department of Transportation, Cambridge, Mass., reported to the Intersociety Conference on Transportation last fall in Denver, Colo. Malliaris applied common sense assumptions to calculate, for example, to figure the fuel saving possible from a conversion of 50 per cent of the vehicle population to 22 m.p.g. small cars. He assumed 90 per cent of today's cars get an average 13.1 m.p.g., while the remaining 10 per cent are small, 22-m.p.g. cars. If the percentage of small cars were increased to 50 per cent, he calculated the resultant fuel saving at 9 per cent. If the data contained much uncertainty, he used an "optimistic scenario" to arrive at a maximum fuel saving.

Still, some of the results appear discouraging. Modal shifts, from inefficient private vehicle to bus or train, "show limited potential for energy conservation," says Dr. Malliaris. A 50 per cent shift of city-bound commuters to buses would only produce a 1.9 per cent savings, though the same shift to *intercity* bus and rail would increase that percentage to 3 per cent. Even more disappointing is the potential saving for a 50 per cent shift of short haul air passengers to intercity bus: 0.29 per cent. Or if 50 per cent of the population started walking or biking on trips



The chart shows various alternatives for saving crude oil displayed as percentage fuel saving. Data is adapted from two studies: *Demand for Energy by the Transportation Sector and Opportunities*

for Energy Conservation, A. C. Malliaris and R. L. Strobotne for the Intersociety Conference on Transportation, Denver, Colo. Sept. 23-27 and *A Study of Technological Improvements in Automobile*

Fuel Consumption, by Donald A. Hurter of the Arthur D. Little Company, Cambridge, Mass.

of up to five miles, the best estimate for fuel saved is only 1.6 per cent. It seems the fraction of miles traveled in trips of under three miles one way is only 6 per cent, which leads Dr. Malliaris to assert that "no substantial transportation energy savings would be realized unless unrealistically long walks are assumed."

Attempts to reduce gasoline demand by running vehicles on alternative fuels brings a whole new set of problems, says Dr. Malliaris. The following possibilities were examined: methane and methanol; propane and ethanol; hydrogen; magnesium hydride, ammonia and hydrazine. These alternatives always lead to a trade-off with not a few disadvantages. For example, he finds that "fuel plus tank weight is higher (for all) than gasoline, but tolerable in most cases, except perhaps liquid hydrogen plus oxygen and magnesium hydride." In another example, the three forms of hydrogen appear to require an unacceptable volume for a passenger car. Only ethanol among the alternatives can approach gasoline in the amount of storage space required for a given amount of energy potential. Methanol, on the other hand, requires

almost twice as many gal./B.t.u. as gasoline. Cryogenic hydrogen is rated poor because of the expensive hardware needed for its containment.

According to Malliaris, "ethanol ranks second with gasoline. . . for automotive application. . . . The first choice is to derive gasoline from shale, coal or by any other means, provided that it is economically competitive. Second, ethanol should be considered as an alternative fuel, if it can be made economically competitive. Propane, methanol and liquid methane . . . are next in the ranking. Cryogenic hydrogen, hydrogen/oxygen and magnesium hydride appear relatively unattractive."

In a related research effort, to determine the fuel saving potential of strictly *vehicle technology* changes, sponsored by the Department of Transportation and the Environmental Protection Agency, Donald Hurter of the Arthur D. Little Company, Cambridge, Mass., calculated the following crude oil savings: diesel engine for passenger cars, 20 to 25 per cent; conventional engine with infinitely variable transmission, 10 to 15 per cent; weight reduction of 200 to 400 lbs., 2 to 8 per cent;

stratified charge engine with open chamber, 15 to 20 per cent; steel belted radial tires replacing fiberglass belted tires, 3 to 5 per cent.

The research indicates fuel savings are possible, but as Dr. Malliaris is quick to point out, "with the automobile you have to have a certain amount of performance, if for no other reason than safety. The result is a car that has to operate with an oversize engine at part load and that is wasteful."—*Michael Chiusano*

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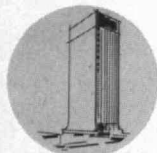
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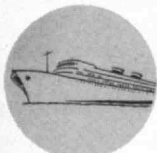
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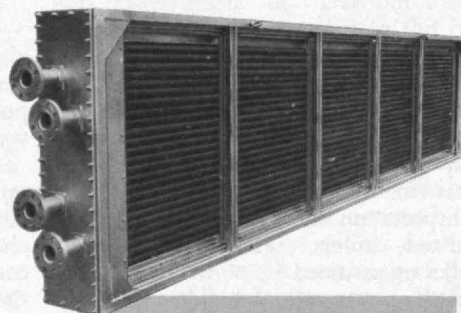
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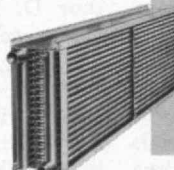
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Man, Bricks, Leaky Boat, Swimming Pool...

Puzzle Corner
by
Allan J. Gottlieb

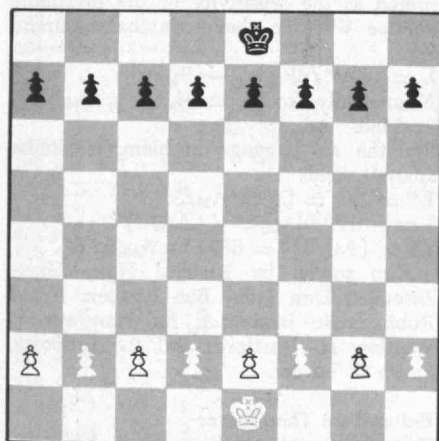
PERM 1, which started out as **O/N 3** last fall (using 1, 9, 7, and 3 and any other mathematical symbols, construct expressions yielding as many numbers as possible) has been a great success; I literally receive mail every day on that problem alone. In the March/April issue, where I first presented the solution, some answers using a decimal point were printed. Now I've become persuaded to disallow such solutions, and below (see "Better Late Than Never") are corrections to substitute new solutions. In addition, many new numbers are presented.

I would especially welcome a proof of **MAY 2**—i.e., that **PERM 1** is possible for all integers. Better still would be a constructive algorithm. Such an algorithm would reduce **PERM 1** to the "hard case"—i.e., no greatest integers function.

The proposer has sent in two corrections to **M/A 4**. For one thing, his name is spelled Bumby (we had it Bumbry). A more serious correction is that the questions need not be addressed one to each guard; the only limitation is that there be at most three questions.

Problems

JUN 1 Harry Nelson would like to know the minimum number of moves needed to reach the following position:



JUN 2 The following is from William Thompson, Jr.:

Consider a regular pentagon whose sides have unit length. Draw the five diagonals of the pentagon thus creating a five-pointed star (a pentagram) which in turn encloses a smaller regular pentagon. If this process is repeated indefinitely show that the sum of the perimeters of the infinity of regular

pentagons so created, including that of the original one, is 5ϕ units where ϕ is the so-called golden mean $[= \frac{1}{2}(1 + \sqrt{5})]$ and that the sum of the perimeters of the infinity of pentagrams so created is ten units.

JUN 3 The following—a puzzle consisting of 256 squares (16×16)—is submitted by Mark Yellon (See diagram on this page.) Certain numbers are entered in 64 of these squares (four on each line). You are to enter in the open squares all the missing numbers from 1 to 256 (no duplications), so that the total of all the numbers in each horizontal row, the total of all the numbers in each vertical row, and the total of the numbers on each of the two diagonal rows (corner to corner) will equal 2,056 in each of the three categories.

JUN 4 The following is submitted by Roy Schweiker:

A man is sitting in a wooden rowboat in

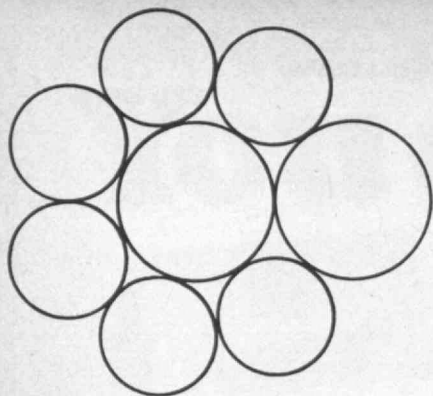
his swimming pool. Both the pool and the boat have gauges on them to measure the water level. How does each gauge reading change as the water level changes, when:

1. The man sits in the boat?
2. The man loads the boat with bricks?
3. The man drops all the bricks overboard into the pool (consider hydrostatic effects only)?
4. The boat develops a fast leak and swamps?

JUN 5 The following was submitted by Gary Ford:

Two large coins and six small coins are placed on a table, each just touching its neighbors as shown in the sketch at the top of the next page. What are the relative diameters of the coins? (Mr. Ford writes that he discovered the problem while counting change; the coins involved were quarters and dimes. The problem has now

256						45	32								205
			248			43		26			197				
	246			41						28			199		
					47	46			31	30					
		66			147					162			115		
	74		72									117		123	
		71		153							172		118		
68							145	164							113
144							93	112							189
		139		85							104		186		
	134		140									185		183	
		142			95					110			191		
					227	226			211	210					
	58			229							216			11	
			60			231			214			9			
52							225	212							1



circulated among his colleagues for about two months without solution, although they have found some tenth-degree polynomials having roots that solve the problem.)

Speed Department

R. Robinson Rowe:

SD 1 The following was submitted by R. Robinson Rowe:

If every day the papa bull eats a third of a bale of hay and the baby bull eats a fifth of a bale, how much does the mama bull eat, if she eats half the sum or twice the difference of what papa and baby eat?

SD 2 Judith Q. Longyear wants you to find the next few terms in the following sequence:

1 2 3 4 5

Solutions The following are solutions to problems published in February:

FEB 1 Find a way for South to make four hearts given a lead of ♠ K:

♠ A 5
♥ 7 6 5 3 2
♦ K 7 2
♣ A 8 2

♠ K Q 10 9 8 4 3
♥ Q J 8
♦ 8 3
♣ 10

♠ J 2
♥ A K 10 9 4
♦ A 6 4
♣ 9 5 4

♠ 7 6
♥ —
♦ Q J 10 9 5
♣ K Q J 7 6 3

The following is submitted by Bill Speaker:

The problem deal need not have specified ♠ K opening lead. Four hearts can be made with either North or South declarer against any opening lead. The simplest approach is described first. Regardless of opening lead, declarer takes all his top tricks, including two trump, two diamonds, one club, and one spade. When declarer next leads a spade, West must win to prevent North-South from making an over-trick. West must lead either a spade or a heart. Declarer must refuse both a trump lead and the first spade lead. On the first spade lead, declarer must slough a club from one hand and a diamond from the other. On the second spade lead, declarer can rough in one hand and void the other hand in clubs. A cross-rough in diamonds and clubs is now established to make the

hand. If West has retained his remaining trump, he can take it at any trick. The easiest alternate play permits declarer to delay drawing trumps until after West has won the second spade lead. Declarer plays the first and second spade lead as before, setting up his cross-rough. When declarer has a chance to play trump, declarer must force West to win the third round of trump, even if West has saved the ♥ 8. West must again lead spades, and declarer is waiting with an effective cross-rough.

Also solved by R. Robinson Rowe, Jim Marlin, John Chandler, George Holder-ness, Richard Bator, Thomas Mauthner, Michael Kay, Richard Hess, N. Poffen-berger, John Dawson, and the proposer, Winslow H. Hartford.

FEB 2 Find all the primes of the form $a^4 + 4b^4$.

The following is submitted by Richard Hess:

$$p = a^4 + 4b^4 = (a^2 + 2ab + b^2)(a^2 - 2ab + 2b^2) = (a^2 + 2ab + 2b^2)(a - b)^2 + b^2.$$

Without loss of generality a and b can be taken as non-negative integers. For p to be a prime number, either (1) or (2) must be true:

- (1) $a^2 + 2ab + 2b^2 = 1$
 $\Rightarrow a = 1, b = 0, p = 1$; or
- (2) $(a - b)^2 + b^2 = 1$
 \Rightarrow either $a = 1, b = 0, p = 1$
or $a = 1, b = 1, p = 5$.

Then the only two solutions are:

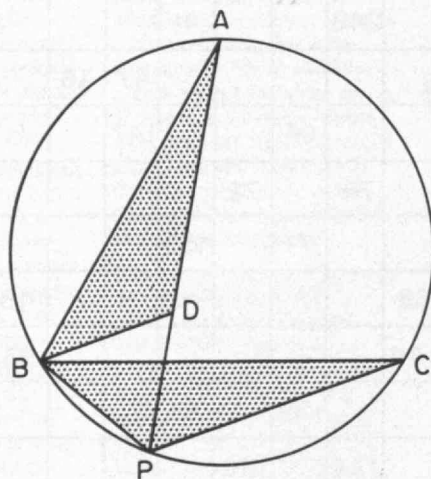
$$a = 1, b = 0, p = 1$$

$$a = 1, b = 1, p = 5.$$

Also solved by Jim Marlin, R. Robinson Rowe, R. E. Crandall, Frank Rubin, Douglas Hoylman, Neil Cohen, Eric Jamin, Richard Bumby, and Winslow E. Hartford.

FEB 3 Let ABC be an equilateral triangle inscribed in a circle. Choose any point P on the arc from B to C. Prove that $PA = PB + PC$.

The following was submitted by Robert Pogoff:



Lay off $PD = PB$. An angle inscribed in a circle is measured by half of the arc subtended by its sides. Therefore angle $BPD = 60^\circ$, and

Triangle BPD is equilateral,

$$\text{Angle BDP} = 60^\circ,$$

Angle BDA = 120° (supplementary angles)

$$\text{Angle BPC} = 120^\circ \text{ (since arc BAC} = 240^\circ)$$

$$\text{Angle BDA} = \text{angle BPC}$$

Angle BAP = angle BCP (both are measured by half of arc BP)

Angle ABD = angle CBP (third corresponding angles of triangles)

$$BA = BC \text{ (given)}$$

$\triangle BAD \cong \triangle BCP$ (the shaded triangles are approximately equal)

$$DA = PC \text{ (corresponding sides)} \quad (1)$$

$$PD = PB \text{ (by construction)} \quad (2)$$

Adding (1) and (2) yields

$$PA = PC + PB$$

Also solved by Eric Jamin, Frank Rubin, R. Robinson Rowe, Jim Marlin, Richard Hess, John Chandler, Ben Rouben, Yvon Neptune, Edward Dennison, John Rule, Dan Jaffe, Gary Venter, Gregorio Hernandez, Mary Lindenberg, Roberta Klein, Harry Zarembo, Henry Lieberman, Paul Kaschube, Winslow H. Hartford, and the proposer, Allen Anderson.

FEB 4 Find a seven-fold homonym in the English language (or six-fold, if proper nouns are excluded).

Neglecting proper nouns and multi-word homonyms (e.g., *Foe Rays*), the maximum was nine by Mary Youngquist: *Ere, air, e'er, eyre, are, ayer, ayre, heir, and are* (the metric measure).

Also solved by Richard Hess, R. Robinson Rowe, Neil Cohen, John Moore, George Delury, Winslow H. Hartford, and the proposer, Jerome Miller.

FEB 5 The parcel post box size is limited by the total of length and girth (twice the width plus the depth) while air baggage is limited by the total of the three dimensions. Say, for example,

$$P_M = L + 2W + 2D = 84$$

$$A_M = L + W + D = 62$$

What is the largest volume box that can be shipped either way (a) generally, and (b) with P_M and A_M as above?

The following was submitted by John E. Prussing:

For the parcel post box, one maximizes the volume $V = LWD$ by maximizing $H = V + \lambda(L + 2W + 2D - P_M)$

Setting $\partial H / \partial L = \partial H / \partial W = \partial H / \partial D = 0$ yields optimal values

$$L^* = 2W^* = 2D^* = P_M / 3.$$

The Lagrange multiplier, λ , can be interpreted as the sensitivity of the maximum volume V^* to a change in the constraint P_M .

$$\lambda = -dV^* / dP_M = -(P_M / 6)^2$$

Numerically, for $P_M = 84$, $V^* = P_M^3 / 108 = 5488$.

For the air baggage problem, a similar analysis yields

$$L^* = W^* = D^* = A_M / 3,$$

$$\lambda = -dV^* / dA_M = -(A_M / 3)^2,$$

$$V^* = (A_M / 3)^3 = 8827 \text{ for } A_M = 62.$$

Also solved by Richard Hess, Harry Zarembo, Dan Jaffe, Ben Rouben, Frank Rubin, Eric Jamin, A. M. Handwerker, Winslow H. Hartford, and the proposer, Smith D. Turner.

Better Late Than Never

Comments and solutions have been received as follows:

JAN 2 Emmet Duffy

JAN 5 John Rule

J/A 5 S. D. Conner has supplied an elementary proof.

Four corrections have been received for PERM 1:

$$97 = 1 + (9 + 7) \cdot 3!$$

$$98 = (9 + 3! - 1)7$$

$$99 = 97 + 3 - 1$$

$$103 = 9! / 7! + 31$$

Eric Jamin has extended the list up to 256, using the greatest integer function for only 20 of these. Tim Mann, using the greatest integer function, has reached 407. Their results follow:

From Mr. Jamin:

$$150 = 9 \cdot 17 - 3$$

$$151 = 3! / 9 + 71$$

$$152 =$$

$$153 = 17 \cdot 3 \cdot \sqrt{9}$$

$$154 = 7 \cdot (31 - 9)$$

$$155 =$$

$$156 = 9 \cdot 17 + 3$$

$$157 = (\sqrt{9}! - 1)! + 37$$

$$158 = (3 - 1) \cdot 79$$

$$159 = 9 \cdot 17 + 31$$

$$160 = 1 \cdot (3! - 71/9)$$

$$161 = 3! - 71/9 + 1$$

$$162 = (7 - 1) \cdot 3 \cdot 9$$

$$163 =$$

$$164 = 91 + 73$$

$$165 = 7 \cdot (3 + 1)! - \sqrt{9}$$

$$166 =$$

$$167 = 173 - \sqrt{9}!$$

$$168 = 9! / 3 \cdot (7 - 1)!$$

$$169 = 13^{(9-7)}$$

$$170 = 173 - \sqrt{9}$$

$$171 = 7 \cdot (3 + 1)! + \sqrt{9}$$

$$172 =$$

$$173 = 179 - 3!$$

$$174 = 7 \cdot (3 + 1)! + \sqrt{9}!$$

$$175 = 7 \cdot (19 + 3!)$$

$$176 = 179 - 3$$

$$177 = 7 \cdot (3 + 1)! + 9$$

$$178 =$$

$$179 = 173 + \sqrt{9}!$$

$$180 = 9 \cdot (17 + 3)$$

$$181 =$$

$$182 = 7 \cdot (3 \cdot 9 - 1)$$

$$183 = (3! - 1)! + 7 \cdot 9$$

$$184 =$$

$$185 = (\sqrt{9}! - 1) \cdot 37$$

$$186 = 3 \cdot (71 - 9)$$

$$187 =$$

$$188 = 3 \cdot 7 \cdot 9 - 1$$

$$189 = 1 \cdot 9 \cdot 7 \cdot 3$$

$$190 = 19 \cdot (7 + 3)$$

$$191 = 197 - 3!$$

$$192 = 3 \cdot (7 \cdot 9 + 1)$$

$$193 = (\sqrt{9}! - 1)! + 73$$

$$194 = (3 - 1) \cdot 97$$

$$195 = \sqrt{9} \cdot (71 - 3!)$$

$$196 = 7 \cdot (3 \cdot 9 + 1)$$

$$197 = 917 - 3!!$$

$$198 = 9 \cdot (3 \cdot 7 + 1)$$

$$199 = (3! - 1)! + 79$$

$$200 = 197 + 3$$

$$201 = 71 / (3 + 1)! - 9$$

$$202 =$$

$$203 = 197 + 3!$$

$$204 = 17 \cdot (9 + 3)$$

$$205 =$$

$$206 =$$

$$207 = 9 \cdot (17 + 3!)$$

$$208 = 3! - (7 + 1)^{(\sqrt{9})}$$

$$209 = 9 \cdot (3 + 1)! - 7$$

$$210 = 3 \cdot 71 - \sqrt{9}$$

$$211 = 7 \cdot 31 - \sqrt{9}!$$

$$212 =$$

$$213 = 3 \cdot (9! / 7! - 1)$$

$$214 = 7 \cdot 31 - \sqrt{9}$$

$$215 = 3 \cdot 9! / 7! - 1$$

$$216 = (7 + 1) \cdot 3 \cdot 9$$

$$217 = (3! - 1)! + 97$$

$$218 = 73 \cdot \sqrt{9} - 1$$

$$219 = (7 - 1)^3 + \sqrt{9}$$

$$220 = 73 \cdot \sqrt{9} + 1$$

$$221 = 37 \cdot \sqrt{9}! - 1$$

$$222 = (7 - 1)^3 + \sqrt{9}!$$

$$223 = 7 \cdot 31 + \sqrt{9}!$$

$$224 = (\sqrt{9}!)^3 + 7 + 1$$

$$225 = 9 \cdot ((7 - 3)! + 1)$$

$$226 = 7 \times 31 + 9$$

$$227 =$$

$$228 = (37 + 1) \cdot \sqrt{9}!$$

$$229 =$$

$$230 =$$

$$231 = 7 \cdot (9 + (3 + 1)!)$$

$$232 = 3! / \sqrt{9} - 7 - 1$$

$$233 = (\sqrt{9}!)^3 + 17$$

$$234 = (7 - 1) \cdot 39$$

$$235 =$$

$$236 = 3 \cdot 79 - 1$$

$$237 = 1 \cdot 3 \cdot 79$$

$$238 = 7 \cdot (31 + \sqrt{9})$$

$$239 = 3! / \sqrt{9} - 1^7$$

$$240 = 3 \cdot (79 + 1)$$

$$241 = 3! / \sqrt{9} + 1^7$$

$$242 = 3^7 / 9 - 1$$

$$243 = (7 - 1) / 3 + \sqrt{9}$$

$$244 = 3^7 / 9 + 1$$

$$245 =$$

$$246 = 3! / \sqrt{9} + 7 - 1$$

$$247 = 19 \times (7 + 3!)$$

$$248 = 3! / \sqrt{9} + 7 + 1$$

$$249 = (7 - 1) / 3 + 9$$

$$250 = (\sqrt{9})^{(3!-1)} + 7$$

$$251 = 971 - 3!!$$

$$252 = 7^3 - 91$$

$$253 = 3! \times \sqrt{9}! \times 7 + 1$$

$$254 =$$

$$255 = (9 + 3!) \cdot 17$$

$$256 = (9 + 7)^{(3-1)}$$

Using the greatest integer function:

$$152 = (7 + \lfloor \sqrt{3} \rfloor) \cdot 19$$

$$155 = (\sqrt{9} + \lfloor \sqrt{7} \rfloor) \cdot 31$$

$$163 = 7 \cdot \lfloor \sqrt{3} \rfloor! - 19$$

$$166 = \lfloor \sqrt{3} \rfloor! \cdot 7! - \sqrt{9}! - 1$$

$$172 = 7 \cdot \lfloor \sqrt{3} \rfloor! - 9 - 1$$

$$178 = 7 \cdot \lfloor \sqrt{3} \rfloor! - \sqrt{9} - 1$$

$$181 = \lfloor \sqrt{3} \rfloor! \cdot 7! + 9 - 1$$

$$184 = 7 \cdot \lfloor \sqrt{3} \rfloor! + \sqrt{9} - 1$$

$$187 = 7 \cdot \lfloor \sqrt{3} \rfloor! + \sqrt{9}! - 1$$

$$202 = 3 \cdot \lfloor \sqrt{7} \rfloor! - 9 + 1$$

$$205 = 3 \cdot \lfloor \sqrt{7} \rfloor! - \sqrt{9}! + 1$$

$$206 = 3 \cdot \lfloor \sqrt{7} \rfloor! - \sqrt{9} - 1$$

$$212 = 3 \cdot \lfloor \sqrt{7} \rfloor! + \sqrt{9} - 1$$

$$227 = 9 \cdot \lfloor \sqrt{3} \rfloor! - 1 \cdot 7$$

$$229 = \lfloor \sqrt{9} / 7 \rfloor + 3 - 1$$

$$230 = \lfloor \sqrt{9} / 7 \rfloor + 1 \cdot 3$$

$$235 = 9 \cdot \lfloor \sqrt{3} \rfloor! + 1^7$$

$$245 = (\sqrt{9}! - 1) \cdot 7$$

$$254 = \lfloor \sqrt{3} \rfloor! \cdot ((\sqrt{9}! - 1)! + 7)$$

From Mr. Mann:

$$257 = (9 + 7)^{\lfloor \sqrt{3} \rfloor} + 1$$

$$258 = \lfloor \sqrt{3} \rfloor!^{(9-1)} + \lfloor \sqrt{7} \rfloor$$

$$259 = \lfloor 7! / 19 \rfloor - 3!$$

$$260 = \lfloor \sqrt{3} \rfloor! \cdot (\sqrt{9} + 7) \cdot 1$$

$$261 = (7 + 3 - 1) \cdot \lfloor \sqrt{\sqrt{9}!} \rfloor$$

$$262 = \lfloor 7! / 19 \rfloor - 3$$

$$263 = \lfloor 7! / 19 \rfloor - \lfloor \sqrt{3} \rfloor!$$

$$264 = \lfloor 7! / 19 \rfloor - \lfloor \sqrt{3} \rfloor$$

$$265 = \lfloor 7! / 19 \rfloor \cdot \lfloor \sqrt{3} \rfloor$$

$$266 = \lfloor 7! / 19 \rfloor + \lfloor \sqrt{3} \rfloor$$

$$267 = \lfloor 7! / 19 \rfloor + \lfloor \sqrt{3} \rfloor!$$

$$268 = \lfloor 7! / 19 \rfloor + 3$$

$$269 = \lfloor \sqrt{(9 - 1)!} \rfloor + \lfloor \sqrt{7} \rfloor! - 1$$

$$270 = (7 - 1) \cdot \lfloor \sqrt{\sqrt{3}!} \rfloor \cdot 9$$

$$271 = 91 \cdot 3 - \lfloor \sqrt{7} \rfloor$$

$$272 = 91 \cdot 3 - \lfloor \sqrt{\sqrt{7}} \rfloor$$

$$273 = 91 \cdot 3 \cdot \lfloor \sqrt{\sqrt{7}} \rfloor$$

$$274 = 91 \cdot 3 + \lfloor \sqrt{\sqrt{7}} \rfloor$$

$$275 = 91 \cdot 3 + \lfloor \sqrt{7} \rfloor$$

$$276 = 3 \cdot (91 + \lfloor \sqrt{\sqrt{7}} \rfloor)$$

$$277 = (31 \cdot 9) - \lfloor \sqrt{7} \rfloor$$

$$278 = (31 \cdot 9) - \lfloor \sqrt{\sqrt{7}} \rfloor$$

$$279 = (31 \cdot 9) \cdot \lfloor \sqrt{\sqrt{7}} \rfloor$$

$$280 = (31 - 9) + \lfloor \sqrt{\sqrt{7}} \rfloor$$

$$281 = (31 \cdot 9) + \lfloor \sqrt{7} \rfloor$$

$$282 = \lfloor \sqrt{7} \rfloor \cdot (\sqrt{9} + 1) + \lfloor \sqrt{3} \rfloor!$$

$$283 = \lfloor \sqrt{7} \rfloor \cdot (\sqrt{9} + 1) + 3$$

$$284 = (\lfloor \sqrt{7} \rfloor + 1) \cdot (7 - \sqrt{9})$$

$$285 = 17 \cdot \lfloor \sqrt{3} \rfloor! - \sqrt{9}$$

$$286 = (31 \cdot 9) + 7$$

$$287 = 17 \cdot \lfloor \sqrt{3} \rfloor! - \lfloor \sqrt{\sqrt{9}!} \rfloor$$

$$288 = 17 \cdot \lfloor \sqrt{3} \rfloor! - \lfloor \sqrt{\sqrt{9}} \rfloor$$

$$289 = 17 \cdot \lfloor \sqrt{3} \rfloor! \cdot \lfloor \sqrt{\sqrt{9}} \rfloor$$

$$290 = 97 \cdot 3 - 1$$

$$291 = 97 \cdot 3 \cdot 1$$

$$292 = 97 \cdot 3 + 1$$

$$293 = \sqrt{9}! \cdot 7 \cdot \lfloor \sqrt{3} \rfloor! - 1$$

$$294 = \sqrt{9}! \cdot 7 \cdot \lfloor \sqrt{3} \rfloor! \cdot 1$$

$$295 = \sqrt{9}! \cdot 7 \cdot \lfloor \sqrt{3} \rfloor! + 1$$

$$296 = (9 - 1) \cdot 37$$

$$297 = 9 \cdot (\lfloor \sqrt{3} \rfloor! + 7) \cdot 1$$

$$298 = 17 \cdot \lfloor \sqrt{3} \rfloor! + 9$$

$$299 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{7} \rfloor!) - 3 + 1$$

$$300 = \sqrt{9}! \cdot \left(7 \cdot \lfloor \sqrt{3} \rfloor! + 1 \right)$$

$$301 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{7} \rfloor!) \cdot 1^3$$

$$302 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{7} \rfloor!) + 1^3$$

$$303 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{7} \rfloor!) + 3 - 1$$

$$304 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{7} \rfloor!) + 3^3$$

$$305 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{7} \rfloor!) + 3 + 1$$

$$306 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{7} \rfloor!) + 3! - 1$$

$$307 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{7} \rfloor!) + 3! \cdot 1$$

$$308 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{7} \rfloor!) + 3! + 1 = 317 - 9$$

$$309 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{3} \rfloor!) + 7 + 1$$

$$310 = 31 \cdot (\sqrt{9} + 7)$$

$$311 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{7} \rfloor!) + \lfloor \sqrt{(3! - 1)!} \rfloor$$

$$312 = 319 - 7$$

$$313 = 39 \cdot \lfloor \sqrt{\sqrt{7}!} \rfloor + 1$$

$$314 = (\lfloor \sqrt{9} \rfloor! / \lfloor \sqrt{7} \rfloor!) + 13$$

$$315 = 9 \cdot 7 \cdot \lfloor \sqrt{\sqrt{3}!} \rfloor \cdot 1$$

$$316 = 317 - \lfloor \sqrt{\sqrt{9}} \rfloor$$

$$317 = 317 \cdot \lfloor \sqrt{\sqrt{9}} \rfloor$$

$$318 = 317 + \lfloor \sqrt{\sqrt{9}} \rfloor$$

$$319 = 319 \cdot \lfloor \sqrt{\sqrt{7}} \rfloor$$

$$320 = 319 + \lfloor \sqrt{\sqrt{7}} \rfloor$$

$$321 = 319 + \lfloor \sqrt{7} \rfloor$$

Prowling Coastal Waters with a Robot Oceanographer

Man is a land animal, and this fact becomes ever more obvious when engineers try to make him mobile in the undersea environment. His eyes are unsuited to seeing in the dark, his navigation is faulty, and the conditions of atmosphere and temperature he needs are hard to create and harder to maintain.

Hence the interest of M.I.T. students in an underwater robot for oceanographic research—and the fact that a team of a dozen undergraduate and graduate engineering students, under the direction of A. Douglas Carmichael, Professor of Ocean Engineering, is well along with the design and construction of such an “artificial fish” with an on-board minicomputer for guidance. With good luck, they think, their device will be ready for testing this summer, and they hope it may be the prototype of a fleet of inexpensive oceanographic research tools.

The robot, which is being designed and built with funds from M.I.T. and the Sea Grant Program, is basically an eight-ft.-long, 250-lb. torpedo-shaped submarine with an aluminum body and fiberglass nose and tail. It's designed to carry 50 lbs. of scientific instruments, most prominently a movie camera and sonar device to function as the robot's eyes and ears.

The purpose of this “artificial fish” will be to prowl coastal waters gathering oceanographic data or searching for the remains of sunken ships; the design is planned to withstand depths of up to 600 ft., which is well beyond those found in coastal waters.

The computer brain of the “fish” will be kept informed of the robot's position and underwater attitude by pitch, roll, and depth sensors, and an electric compass. With this information, plus course and speed instructions preprogrammed into it by its operators, the robot will trace out a prescribed course,

controlling its instruments and sending information and pictures back to the scientists on board a mother ship.

“As far as we know there are no other relatively simple shallow-water oceanographic robots such as this one,” says Professor Carmichael. And he thinks “an oceanographer with a fleet of 20 of these robots could automatically scan large portions of ocean very quickly and precisely”—a potential revolution for scientists who are accustomed to taking data by hand from research vessels guided in grid patterns over waters under study.

The M.I.T. students began building their robot after having considerable success last year with a previous design project—a sonar-equipped “pollution-chaser” which floats just under the water surface. By tracking the movement of this underwater buoy, the students



This robot for oceanographic research is being developed by M.I.T. students under direction of Professor A. Douglas Carmichael (right); with elaborate automation, the robot may be the answer to oceanographers' dreams of a way to make quick surveys of shallow bottoms. With Professor Carmichael are two M.I.T. freshmen working on the project, Deborah S. Hoover and Arlie G. Sterling.

found they could trace the flow of pollutants down rivers and through coastal bays.

According to present plans, the prototype robot will be finished in time for testing this summer during a cooperative summer program at the Maine Maritime Academy in Castine.

A Methanol Economy? A Study Center to Weigh the Many Answers

Is methanol the “fuel of the future”?

Intrigued by the ideas of two M.I.T. engineers (see *March/April*, pp. 61-62) who have been adding methanol to the gasoline tanks of their cars for about a year now, John B. Hawley, President of the Northern Pump Co., Minneapolis, has made a \$100,000 gift to the M.I.T. Energy Laboratory for a Methanol Study Center.

The Center will focus on work of the two Lincoln Laboratory scientists, Thomas B. Reed and Robert M. Lerner, who say that methanol is a clean, liquid fuel which can be produced from a variety of sources and which can be added to gasoline to improve fuel economy, increase octane, and decrease emissions in cars with no engine alterations.

Mr. Hawley, who is “keenly aware of the ultimate depletion of our valuable petroleum,” Dr. Reed says, first called him early this year to suggest the possibility of making a donation for methanol study through M.I.T. Two months of discussions at M.I.T. and with representatives from the oil, mining, and automotive companies led to the grant, one of the first proposals to be funded in the M.I.T. Energy Laboratory.

It will be used to test private cars and research engines with methanol-gasoline blends, to test the chemical behavior of these blends, and to determine the relative toxicity of methanol, lead and other gasoline additives.

Mr. Hawley has also made a grant to Texas A and M University to continue work there on methanol production

The check in the picture is the gift of the man who isn't there—John B. Hawley, Jr., a Minneapolis businessman who is "placing his bet on the methanol economy." Mr. Hawley's \$100,000 is being passed by Thomas B. Reed of Lincoln Laboratory, right, to David C. White, Director of M.I.T.'s Energy Laboratory, where it will be used to establish a Methanol Study Center in which Dr. Reed and Robert M. Lerner will continue studies of methanol as an alternate energy source. The man in the middle is Albert G. Hill, Vice President for Research at M.I.T.



from coal.

"For most of his 74 years Mr. Hawley has been active in invention, engineering, and management," Dr. Reed says in describing his benefactor/partner. "During World War II his company produced \$900 million worth of ordnance and machinery for the Armed Forces and never missed a deadline." Now, at 74, Mr. Hawley's chief pleasures are raising cattle, the oil business, and financial gambling. He is placing one bet on methanol.

A Setback for the Dream of Man-Powered Flight

Remember BURD (Biplane Ultralight Research Device), a 126-lb. two-man-powered aircraft which M.I.T. students designed to compete for a prize offered by Henry Kremer, the British industrialist (see *Technology Review* for October/November, 1973, p. 76)?

Sad news: a setback.

"Structural failure" during a planned high-speed taxi test early this spring.

BURD was built a year ago, and testing (possible only under the most favorable weather conditions) has been continuing apace since then. The probable cause of this spring's failure was a deterioration in the strength of the balsa wood at the trailing edge of the wing. Witnesses said the wings folded forward and upward.

When BURD came to rest, the lower wings were loose but had not separated completely from the fuselage; there was also damage to the fuselage and to the upper right wing. But many of the vehicle parts appeared to be reusable. No one was injured.

BURD's speed at the time of the incident was thought to be slightly in excess of that required for take-off, and in fact the craft was probably in flight at the instant of failure. So M.I.T. students are "at least confident the basic design has merit," said an official statement; and the students "are considering plans for the redesign and repair of the craft."

College Contributions Reach New High

Contributions to U.S. colleges and universities rose nearly 11 per cent, to a new high estimated at \$2.240 billion, in the year ending June 30, 1973, says the Council for Financial Aid to Education.

Harvard University reported the largest amount of total support, with \$57,154,814 in gifts and grants. Though it did not place among the top ten recipients in the nation, M.I.T. followed Harvard in New England, reporting income of \$21.6 million.

Unrestricted giving was 34 per cent of all giving reported—a new all-time high and by far the largest single category for which money was received, according to C.F.A.E. And alumni participation in annual giving programs was up 0.5 per cent over the previous year, to 17.6 per cent. But that's still a far cry from the 20 per cent participation of the 1960s.

Satellite Experiment: for Students "Most Unusual"

When the Naval Research Laboratory's SOLRAD 11 Satellite is launched next year, there will be something different about its solar wind experiment: a major part of the design work will be the product of undergraduate students.

"It's most unusual," thinks Alan J. Lazarus, Senior Research Associate in Physics, for undergraduates "to build something as sophisticated as this."

The solar wind is composed of particles ejected from the nuclear maelstrom on the sun which stream out through the solar system; the details of their interaction with the earth's magnetic field gives important information about the earth and the sun alike, and the SOLRAD solar wind experiment will contribute another small increment to knowledge of this interaction.

But perhaps more important is the experiment's role as a teaching tool, thinks Dr. Lazarus. A corollary is its

low cost—some \$300,000, "a relatively small amount for such an experiment," he says. One reason is that "people such as parts suppliers have been willing to give us a break on prices, knowing that students were involved in the project."

Briefly Noted . . .

Fellowships

Some 11 per cent of all new graduate students who will hold National Science Foundation Fellowships in 1974-75 will use them to attend M.I.T.—a total of 57 new students; that's more than will be used at any other U.S. university. Two M.I.T. undergraduates interested in teaching careers will hold Danforth Fellowships next year—out of 100 such Fellowships awarded



Six students at M.I.T.—including (left to right) Grzegorz M. Madejski, Esther Hu, '74, and Patrick W. Bosshart, '74,—have designed the electronics (from breadboard stage to final testing) for a solar wind experiment that will be aboard the Naval Research Laboratory's SOLRAD 11 Satellite in 1975. "... most unusual for students to build something as sophisticated as this," says Alan J. Lazarus (behind) of M.I.T.'s Center for Space Research, which has a \$300,000 contract with N.R.L. for the project.

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throughout the U.S.; eight Sloan Research Fellowships for scientific research (out of a total of 78 given by the Alfred P. Sloan Foundation) have come to M.I.T. faculty; and nine of 30 Hertz Foundation fellowships awarded this spring for graduate study in engineering and applied science will be used at the Institute.

Oil Money for Nutrition?

An integrated national nutrition program for Indonesia is the goal of a new study in M.I.T.'s International Nutrition Planning Program. The opportunity for Indonesia arises in a budget surplus generated by growing oil revenues, and the question is how these new funds may be best used to improve Indonesian nutrition. Among suggestions of a team visiting Indonesia from M.I.T. this winter: village-run nutrition clinics, accelerated soy production, child development centers, and fortification of basic foods—salt with iron, wheat with vitamins and minerals.

Leukemia in Mice

Dr. Paul D. Gottlieb, Assistant Professor of Immunology, will use a grant of over \$150,000 from the National Cancer Institute to study the immune system of mice which are highly susceptible to leukemia, seeking the mechanism by which certain antibody molecules participate in immune processes and in leukemia.

Nisbet

Continued from p. 5

the long run, an inexhaustible or renewable source of energy. Man-made lakes fill up with sediment, on time scales which depend on their size and the human activity in their watersheds, but which are often measured in decades, rarely more than a few centuries. Unless we propose then to remove the dams, and to dig out the sediments to restore the fertility of the floodplains below, the opportunity to harness and control the rivers is then terminated. Perhaps we should treat hydro-electric power conversion as consumption of a "fossil fuel"—the unfilled space in a valley. By harnessing water running downhill to generate power, what we are really trying to do is to capture the solar energy that raised it. Would it not make more ecological sense to utilize solar energy directly, and to maintain the value of the natural systems in rivers and estuaries into the bargain?

Ian C. T. Nisbet, Associate Director of the Scientific Staff of the Massachusetts Audubon Society, holds a Ph.D. in physics from Cambridge University (1958). He currently is working on population biology and chemical pollution.

The Job Market: Good Now, and Growing Better

Paul E. Schindler, Jr.
Contributing Editor
The Tech

By the time you read this, Dean William Pounds of the Sloan School of Management will have handed me my Bachelor of Science degree. What will happen next?

Judging from a sample group of my friends, most of us know what we want to be doing next year—and probably thereafter. About half will go on to graduate school. Most of the rest are going to work, and of these the unlucky few who have not yet found jobs are the victims either of bad timing or poor market conditions for their skills. I know at least one literature major who hasn't found a position yet and an architecture student who decided to go on to graduate school after he took a look at the job market in architecture.

Since I was not certain how representative was my sample of friends, I checked with Robert K. Weatherall, Director of Career Planning and Placement.

Right off, my sample was vindicated. "These are terrible times for people with degrees in architecture," Mr. Weatherall said. Things are so tough that one student, Paul Lipof, wrote to all of the Department's alumni on behalf of his fellow students.

As to the job situation in M.I.T.'s four other schools, Mr. Weatherall says engineering is doing very well; science and management are doing well enough, though they've had better years; and as far as he knows, most people from the School of Humanities and Social Sciences will go on to graduate school. "More so than in other schools at M.I.T., people from the School of Humanities tend to have individualistic job goals, so it is hard to spot a trend," he says. All schools' statistics are affected by the skyrocketing number of M.I.T. students going on to medical and law schools.

This is the time of year when a graduating senior really asks him or herself, "Was it worth the extra \$10,000 to go to M.I.T. instead of State?" (In my case, Oregon State, where I think the annual tuition is about \$900.) It depends on what you want, of course, but Mr. Weatherall has an answer for that question: "At Oregon State you'd have been interviewed by local firms. At M.I.T., you are interviewed by national firms, which tend to make better offers and put you on a more exciting career ladder."

The Big Picture

This is the time of year for survey reports of the college placement situation in the mass media, and it's interesting to see how M.I.T. experience compares with these findings.

Deutsch, Shea, and Evans, a New York advertising agency that calculates the demand for engineers as a function of recruiting advertising in selected newspapers and journals, says its engineer/scientist demand index has "surged upward" and by March was at the highest level in five years. It's one-third higher than a year ago, and D.S. & E. expects it will stay at this high level for the rest of 1974.

The *New York Times* headline, "Fewer Engineers Produced in 1973," sounds a lot like the headline on a press release from Engineers Joint Council. The press release says that there will be fewer engineers graduating this June than last and that—based on present enrollment figures—this trend will continue for at least five years. The article adds what we all know: the difficulty of transferring into engineering from other courses makes it unlikely that the trend can be reversed in the short term.

Since the national trend is downwards, while M.I.T.'s enrollment remains stable or rises, the Institute will be graduating an increasing percentage of the national supply of engineers. Our graduates already dominate some fields; this will only make the situation worse. Or better.

Time Magazine's coverage is also on the positive side, noting the greatly increased recruiting activity on campuses all over the nation. Mr. Weatherall agrees: recruiting at M.I.T. has increased this year.

Time claims that this year's students have a "better" attitude towards business. True: the Class of '74, the first class to graduate that saw none of the campus turmoil of the 1960s, doesn't harbor anything like the bitter resentment towards corporate America as a personal enemy that marked even the Class of 1973. Capitalist aspirations are acceptable, if not commendable. There are still sneering references about Dow and napalm, I.T.T. and bribery, or Honeywell, referred to as "the other bomb company" for its work with anti-personnel weapons. And the armed services are still held in low esteem, although it is now possible for R.O.T.C. members to walk across campus

in their uniforms with only a minimal barrage of taunts and insults from their fellow students.

Women are slowly but surely getting into engineering and management at M.I.T., reducing the incredulity of the many faculty who still tend to gasp with astonishment when a "mere girl" declares herself an electrical engineering major, takes a shop course, or does better on a test than the men in the course. And women are finding jobs in the real world more easily as the realization dawns on employers that women can do the work. Some particularly slow-witted employers are also learning that they will lose federal contracts if they don't stop discriminating against women. Indeed, *Time* calls this "the year of the woman," stating that females will get 24 per cent of all the jobs to be filled by graduating students this year, a 54 per cent increase over last.

Women are still asked questions that men with similar credentials don't get asked, and they often are paid less, but at least they are being hired. According to women students I know, the most irritating question, or implication, has to do with children. The "women-will-just-get-pregnant-and-leave" syndrome should lose its force under relentless hammering from legal and societal changes now underway. The rights of pregnant women to continue working are being extended, and there's another major societal change, at least among M.I.T.-educated people: The increased role of the father in child-rearing, which may make the question of government day-care redundant. The eyes of industry will certainly be opened the first time a "bright young man" asks for a year off without prejudice to his career while he stays home to take care of the children.

Although a black woman engineer is supposed to have absolutely the most going for her among this year's job seekers, people who understand Affirmative Action know that it is still competence that counts. And as long as that is the case, those of us who graduate from M.I.T.—whether white or black, male or female—will do OK.



Photo: Daniel L. De Hainaut, '74, from Technique. See p. 69

Institute Review

Inflation and the Budget: Projecting the First Operating Deficit in Recent History

An "extraordinary inflation in the cost of energy and of other materials and services" has struck the Institute in the last six months. The result is an unbudgeted increase of \$1.3 million in the cost of energy for 1973-74 and a total of \$1.5 million of other unprogrammed expenses; and an operating deficit of expenses in excess of revenues and unrestricted income totalling \$1.7 million has been forecast for the current fiscal year by Paul E. Gray, '54, Chancellor.

It will be "the first time in recent history that there has been an imbalance in the operating budget of the Institute," Dr. Gray told the faculty in a special report this spring, and meeting it "will require use of discretionary reserves that have been accumulated in prior years by allocation of unrestricted funds to reserve accounts."

Last September when he previously reported to the faculty (see *Technology Review for December*, pp. 97-98), Dr. Gray warned that 1973-74 would place "extraordinary demands" on M.I.T.'s funds. He then forecast a need for \$7.1 million in unrestricted funds to meet 1973-74 operations; to meet that need would not require the use of discretionary reserves, he said.

Since then four factors have combined to increase the Institute's estimated operating expenses by a total of \$2.8 million:

—Though energy consumption, including both heat and light, has been cut by 25 per cent through widely successful conservation efforts, M.I.T.'s total energy cost for 1973-74 will be \$4.5 million, an increase of 40 per cent over the \$3.2 million in the budget. Residual oil for heating, for example, was budgeted at \$4.80/bbl. 15 per cent more than last year—but the recent price is \$14/bbl.

—The M.I.T. Press, which operates as an auxiliary activity, "moved abruptly into a deficit position" in 1973, and revenues will also be below expenses in 1974, Dr. Gray said; a cumulative deficit of \$900,000 must be met in 1973-74.

—The \$17 million Turnkey Housing for the Elderly project in Cambridge which M.I.T. turned over to the city of Cambridge this spring (see *May*, p. 81) actually cost about \$500,000 more than was reimburs-

able by the Department of Housing and Urban Development. This is \$300,000 more than the available contingency fund, and the result is a nonrecurring cost of that amount to be met in 1973-74.

—Other budget changes, most of them occasioned by rapid inflation in the prices of goods and services the Institute must buy, have added \$300,000 to estimates of the current year's expenses.

The Institute's budget shows five broad categories of income—tuition and fees, contract allowances for indirect costs, restricted grants and gifts, income on endowment and other invested funds, and unrestricted funds. In the best of times, the unrestricted funds can be used for buildings, equipment, new curricula, unsponsored research, or other special purposes—or can be added to endowment in order to increase future endowment income.

But in 1973-74, the excess of expense over all nondiscretionary income, originally estimated at \$7.1 million, will in fact be \$9.9 million, Dr. Gray told the faculty.

To meet that need, the Institute will use all the unrestricted funds which become available in 1973-74, expected to include \$1.2 million from patent royalties, \$1.2 million from use-of-facilities allowances, and \$1.3 million from unrestricted gifts, grants and bequests. In addition \$1.1 million is available from similar unrestricted funds set aside in 1972-73, and \$3.4 million will be drawn from the research reserve. (Use of funds from this reserve is based on the fact that part of the 1973-74 financial problem is in fact caused by a shortfall in recoveries of indirect costs on sponsored research. Upon divestment of the Draper Laboratory effective last July 1, M.I.T. agreed to freeze for 1973-74 the indirect costs for government-sponsored research at levels agreed upon in 1972. The agreement made then did not contemplate today's inflation.)

When all this is done, there will remain a deficit of \$1.7 million which will have to come from income-producing reserve funds—an "undesirable" solution, said Dr. Gray, for two reasons: use of the capital of these funds deprives the Institute of their future income; and the funds themselves are so small that they "would quickly be exhausted were such an imbalance to continue."

Hence Dr. Gray's promise of efforts toward reductions in the operating bud-

get in future years "even more significant" than those made for 1972-73, when gross reductions came to about \$3.5 million. He promised "a careful review of all operating areas, and the planned reduction or elimination of activities that are not central to the Institute's mission." The problems of the M.I.T. Press "are now under intensive review," he said, and funds for curriculum development have been temporarily suspended.

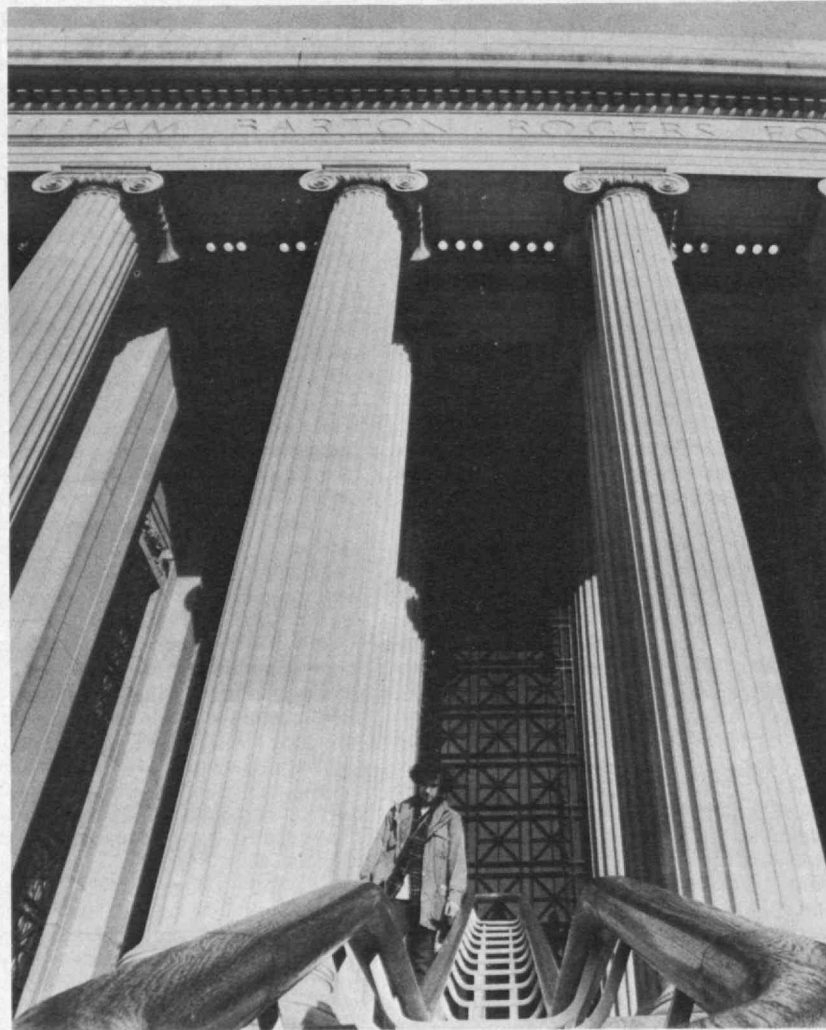
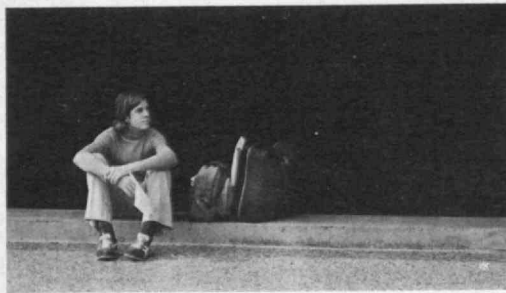
There will be serious efforts on the other side of the ledger, too—to expand gift income and increase endowment, to make a modest growth in the number of students, to intensify the use of M.I.T. facilities in the summer. "The combination of new income generation and cost reductions must approach \$4.5 million if the Institute is to operate with a balanced budget in 1975-76," Dr. Gray told the faculty.

1,670 Admitted to the Class of 1978; More Women, More Minorities, More Applicants

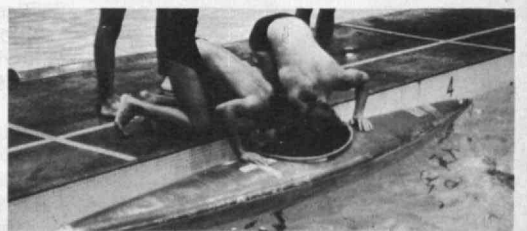
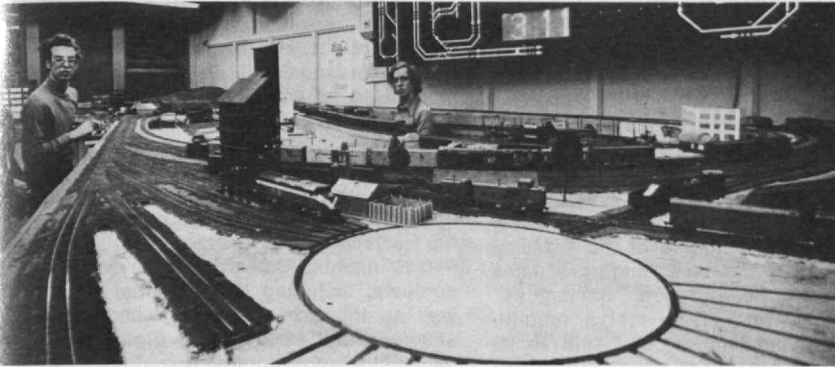
Seeking 1,000 freshmen to enter M.I.T. next fall, the Admissions Office this spring invited 1,670 young people from throughout the U.S. and overseas to join the Class of 1978.

But it was no cinch for Peter H. Richardson, '48, Director of Admissions, and his staff. Though the size of the class was to be increased by 100 over that of the Class of 1978, applications were up by a far larger factor: 4,469 this year, in contrast to 3,881 last year. The applicants were able, and the task of selecting those to be admitted—and the small number who were to be given places on a waiting list—tested everyone's skill and patience. Indeed, Mr. Richardson thinks that many students who were admitted to M.I.T. last year would not have been included this year because of "the marked increase in academic quality" of those in the new Class of 1978.

Those admitted included 341 women, 70 blacks (of whom 29 are women), 16 Mexican Americans (one woman), eight Puerto Ricans (four women), one American Indian (male), and 52 students from foreign countries (other than Canada). The number of women offered admission was the highest in M.I.T. history—as was the number of women applying: 852, up 93 per cent from the previous



"A photographic record of the year at M.I.T."—as Editor, that is how Daniel L. De Hainaut, '74 (left, rear, in the photo below) describes the simple goal of Technique 74, the M.I.T. yearbook. The book is pure photojournalism—almost no words at all; hence this collection (see also p. 66) of some of its notable pictures of "what you might have wanted to see, had you been there, or what you might want to remember because you were there." The other members of the Managing Board in the picture below are (left to right) Suzanne L. Robidoux, '75, Business Manager; Robert J. Dubner, '75, Photo Editor; and James E. Smith, Jr., '76, Managing Editor. For copies of the book, send \$12 to Technique, Box 5, M.I.T. Station, Cambridge, Mass., 02139. (Photos: William A. Anderson, Jr., '76, Mr. De Hainaut, Daniel P. Dern, '73, Robert A. Iannucci, '77, Edward J. McCabe, '75, J. Alan Ritter, '74, Mr. Smith, and Frank J. Venuti, '74)





When a high school senior receives a letter about admission from M.I.T., it is the real thing—signed in person by Peter H. Richardson, '48, Director of Admissions. Some 4,270 such letters were signed by Mr. Richardson this spring, 1,670 of them granting admission to the class of 1978, and over 2,600 letters—also individually signed—to other students who had been placed on M.I.T.'s waiting list or whose applications had been unsuccessful. To avoid writer's cramp, Mr. Richardson encases his pen in a large wooden dowel.

year. But only 216 blacks were among the applicants, 4 per cent of the total. Though this was a 40 per cent increase over 1972-73, Mr. Richardson remains dissatisfied: "We still have not found adequate ways to increase the minority representation at M.I.T. as much as we want.

"Finding minority students with adequate preparation in high school mathematics and science is still one of the most important and difficult tasks facing the Admissions Office at M.I.T.," he thinks.

Financial Aid: The Self-Help Threshold Remains Unchanged

The number of high school students granted admission to M.I.T. who in fact elect to enroll in the Class of 1978 (see above) will depend to some unknown extent on the amount of financial aid they can expect. Good news, then: in spite of inflation, M.I.T. has "held the line" on the "self-help threshold" for 1974-75; it remains at \$1,750.

This means that the first \$1,750 of any student's need, as determined by a comparison of his family resources with the

typical student budget for a year at the Institute, will be met with part-time work and loan. All need in excess of this amount will be met by scholarship assistance.

In addition, the Student Financial Aid Office has suggested four financial alternatives available to all M.I.T. students, irrespective of need and family income:

—Term-time jobs, averaging 8 to 12 hrs./wk., usually on the campus and often of "an educational nature," are likely to be available through the Office of Student Employment.

—Loans under a Federal Guaranteed Loan Program administered by the states are available through lending institutions throughout the country.

—Banks and lending institutions have many commercial deferred payment plans.

—M.I.T. offers a deferred plan which allows payments for each term to be spread over four installments in order to help even the cash flow problem.

A New Requirement in the Humanities, Arts, and Social Sciences: Toward Flexibility, Excellence, and Involvement

Beginning with members of the Class of 1978, entering next fall, undergraduates at M.I.T. will fulfill a new "humanities" requirement which is in fact a requirement in the humanities, arts, and social sciences far broader in concept than any previously adopted by the Institute faculty.

The new requirement, approved after lengthy and sometimes heated debate in faculty meetings during the spring, directs that:

—Each undergraduate include in his/her curriculum three subjects, each in a different field of study, which are "humanistic" in orientation—the "distribution" requirement;

—Each undergraduate take three or four subjects in a single field of study within the humanities, arts, and social sciences—the "concentration" requirement; and

—Each undergraduate take a total of eight subjects in the humanities, arts, and social sciences before receiving a bachelor's degree.

The new plan was brought to the faculty by the School Council of the School of Humanities and Social Science, with the endorsement of the Committee on Educational Policy, to accomplish three purposes:

—To expose M.I.T. undergraduates more fully to the broad range of studies in the humanities, arts, and social sciences now available at the Institute.

—To give students a wider opportunity to select topics in which they have special interests.

—To involve many more faculty, including some in the Schools of Engineering, Management, and Science, in teaching subjects which meet the Institute requirement in the humanities, arts, and social sciences.

The new requirement replaces one which has been substantially unchanged since early in the 1950s, when it was adopted in response to recommendations

of a Committee on Educational Survey chaired by Warren K. Lewis, '05, Emeritus Professor of Chemical Engineering. The previous requirement in the humanities and social sciences was for one subject, chosen from a limited number of freshman and sophomore options, in each term of the first two years and four subjects in the humanities and social sciences in the junior and senior years, three of them to be in one field and the fourth in some different field—a total of eight subjects in four years.

Dealing with Ambiguity and Complexity

In at least three respects the new requirement is more flexible than its predecessor:

—Only five or six of the eight required subjects are governed by the "distribution" and "concentration" requirements. This leaves at least two of the eight subjects as unspecified electives—what Dean Harold J. Hanham of the School of Humanities and Social Science describes as "a sort of island protected from requirements to help students take up subjects that will stand them in good stead for the rest of their lives."

—There are no subjects specifically designated, to the exclusion of others, for the freshmen and sophomores.

—It is intended that a far wider range of subjects, including those in the arts as well as those in humanities and social sciences, will be available to satisfy all aspects of the requirement.

The "distribution" requirement was the subject of keenest faculty debate: how to define subjects which are clearly 'humanistic', which will convey to students a sense of human values, a feeling for the flow from the past to the present to the future, "the feeling for ambiguity and complexity that is in a very special way the province of literature," as Nathan Sivin, '52, Professor of the History of Science, put it. Murray J. K. Biggs, Assistant Professor of Literature, formalized his concern by asking the faculty to specify that students take "at least three subjects that are obviously humanistic."

The decision is left to a new Committee on the Humanities, Arts, and Social Sciences Requirement of 11 faculty and two undergraduate students; its members will include one faculty each from the Schools of Engineering, Management, and Science—the first time faculty from these Schools have been asked to contribute at this level to decisions pertaining to humanities—and seven faculty from among the 15 fields in which the "concentration" requirement may be fulfilled.

To this Committee will go the task of resolving the vexing question of which subjects given at M.I.T. meet the objectives adopted by the faculty: "... to develop skill in communication, both oral and written ... knowledge of human cultures, both past and present ... concepts and systems of thought that underlie human activities ... social, political, economic, and legal framework of our society ... sensitivity to modes of communication and self-expression in the arts."

In particular, the Committee is instructed to "ensure that the 'distribution' subjects are 'humanistic' in orienta-

tion," displaying "a concern for the understanding of human values in their social, historical, and cultural context" and calling for "reading, writing, and classroom discussion to demonstrate that concern." The "distribution" subjects as finally approved will surely include some in the social sciences, arts, and music, as well as many in history, literature, and philosophy.

The fields in which the "concentration" requirement may be fulfilled have now been designated, and faculty within those fields are now establishing their own "concentration" programs. The fields are anthropology and archeology, creative writing, economics, foreign languages and literature, history, history of art and architecture, labor in industrial society, linguistics, literature, music, philosophy, political science, psychology, urban studies, and visual arts and design.

The Committee on the Humanities, Arts, and Social Sciences Requirement will designate a list of subjects from which students may choose their "electives." It is assumed that this list will encompass virtually all subjects given in the School of Humanities and Social Science, a substantial number of those given in the School of Architecture and Planning, and possibly some given in the Schools of Engineering, Management, and Science.

Extending the Responsibility for Values

Why a change from the humanities and social science requirement which has stood for 20 years at M.I.T.? Several reasons:

—To respond to the broadened experience and interests which freshmen now bring to the Institute. Student dissatisfaction with the previous system was "substantial," Dean Hanham told the faculty, and there was no mechanism to make it responsive to changing needs. "It is poor education," thinks Donald L. M. Blackmer, Associate Dean of the School of Humanities and Social Science, "to compel students to go through a kind of experience which they feel they've already had." Indeed, he said, "there is nothing so deadening for the educational process as students being forced into subjects they do not want to take, and nothing so deadening to the faculty, either."

—To open to freshmen and sophomores the broad range of studies in the humanities, arts, and social sciences which are in fact represented at the Institute. In 1950, when the previous requirement was adopted, a total of 26 subjects were given in economics, 25 in English and history, and 17 in modern languages. Today six departments in the School of Humanities and Social Science cover ten disciplines and offer a total of nearly 400 undergraduate subjects. This 22-year growth is little appreciated outside of the Institute, and the remarkable depth and diversity of the School, which Dean Blackmer thinks may not be well understood even within the Institute, could hardly be effectively sampled by undergraduates under the previous requirement.

—To improve the teaching of all M.I.T. subjects in the humanities, arts, and social sciences by increasing the commit-

ment of students to them. Under the new requirement freshmen and upperclassmen will share classes; there will be no "freshman" and "sophomore" subjects. Mixing upper- and lower-classmen will add to the interest of both and help faculty make all these subjects more rigorous, thinks Dean Blackmer.

—To broaden the base of concern within M.I.T. for teaching which puts the present in the context of the past and our society in the context of others and which encourages what the proposal for the new requirement called "those creative and expressive activities which enrich life." It was in his inaugural address in October, 1971, that President Jerome B. Wiesner called for "(an integration of) science and technology with the study of man and his culture . . . (to) recast the concept of a liberal education in a contemporary mold." During the faculty debate on the new requirement he returned to this point: "Can we expect a small group of faculty (in the School of Humanities and Social Science) to carry the responsibility for values for all of us?" he asked.

The depth and intensity of the faculty debate itself, thinks Dean Blackmer, is "a tangible sign of the increasing concern in the science and engineering faculty for the humanities in a broad sense," of a "deepening commitment throughout M.I.T. to bringing quantitative and qualitative elements together into professional education."

If Advanced Economies Are So Rich, Why Are There So Many Poor Among Us?

More than a year ago the Ford Foundation asked some 100 American and Canadian universities to propose useful research on "problems common to advanced industrial societies." The result was 61 submissions, and now 13 universities—including M.I.T.—have been awarded grants for new studies.

The Institute's research, to be directed by Suzanne Berger, Associate Professor of Political Science, will be on "processes responsible for patterns of inequality in income and economic opportunity" in industrial nations. The \$150,000 three-year grant to M.I.T. is the maximum award which Ford said it would make.

Professor Berger has a theory that "one reason for persistent poverty is that it permits an economic system to shift the costs of economic change and fluctuation onto the least-well-protected groups in a society." Her purpose will be to prove or disprove that theory and then—if she confirms it—to suggest some alternative arrangements.

The problem is what Dr. Berger and her associates call "economic dualism"—a situation in which a "modern" economy is introduced alongside an older, "traditional" one. The "modern" economy's wages are high, the "traditional" one's low, because they derive from labor-intensive small business. Such dualism, says Dr. Berger, is usually considered a transitory phenomenon of a developing country. But it continues to exist in developed societies, and now she thinks it may be deliberately fostered there. If



There is something for everyone in "A Funny Thing Happened on the Way to the Forum," and everyone who saw this spring's production of the classic by the M.I.T. Musical Theater Guild liked it. Old grads may wonder what happened to "Tech Show," the tradition of an annual M.I.T.-written musical; the answer is that the Musical Theater Guild advertised for scenario and script but drew none which would pass muster. Perhaps next year . . . (Photos: Scott Tobias, '77, from Technique and Margo Foote)

technologically based change is a fundamental part of development, then such "economic dualism" may be a basic quality of a developed nation.

The Ford Foundation made its original proposal, says McGeorge Bundy, President, because the subject deserved more research than was being done on university campuses.

A New Undergraduate Residence: 300 Beds, \$5.5 Million by 1975

Construction began in April on a new \$5.5 million West Campus residence for 300 undergraduates.

The five-story building will consist of six "houses" connected by a central arcade which will also continue eastward to link with neighboring MacGregor House. The site is north of Memorial Drive and west of the existing Houses—between MacGregor House and the Tang Residence Hall. The individual "houses" in the new structure will have capacities ranging from 39 to 64 students. Each will be a distinct unit with its own house government and style. The result will be flexibility—so that individual "houses" can be single-sex or coeducational, for example, depending on housing demand and the residents' wishes.

Completion date is September, 1975, but Richard A. Sorenson, Executive Assistant to the Vice President, Operations, warns that this date "seems very optimistic." It "depends heavily upon the availability of materials and of fuel for temporary winter heating," and he fears delays.

Completion of the new residence will increase M.I.T.'s undergraduate housing capacity from 1,940 to 2,240 students—and it will probably pave the way for a modest increase in total undergraduate enrollment.

Construction will be carried out in two phases. Work is now under way on the eastern end of the project; construction on the western end will begin this month, following demolition of the building recently occupied by Joyce Chen Restaurant—formerly by Smith House—which occupies part of the site.

The building is the first at M.I.T. to be designed by Sert, Jackson Associates of Cambridge. Contractor is the Turner Construction Co.

Another "first": the first M.I.T. residence hall to be air conditioned—the cost of that advantage to be amortized through extra income from summer rentals to participants in Special Summer Programs.

Hard Work and Long Hours: "Revving Up Again" at M.I.T.

What's the mood of M.I.T. this year?

Hard work and constructive change, says Dr. Carola Eisenberg, Dean for Student Affairs.

There is "intense interest" in academics and large participation in research, and the libraries "were never more used," Dean Eisenberg told members of the Alumni Advisory Council early this spring.

And one persistent characteristic: many students are turning away from

pure science and even from technology to show their concern for social good. For example, in the Class of 1974 are at least 172 applicants to medical school—nearly 20 per cent of the graduates—and 55 applicants to law school. (Last year a remarkable 88 per cent of M.I.T. seniors who applied to medical schools were admitted to at least one institution, Dean Eisenberg said.)

Some student opinions from guests brought to the meeting by Dean Eisenberg:

The fraternities are "revving up again," and the Interfraternity Conference is in general "pleased at the way things are going with fraternities." The trend in fraternity life is back toward events alumni will remember from their college days: more parties, more "fun" with pledges, said Lawrence W. Dagate, '74.

Everyone hears about "very tight housing" at M.I.T., including dormitory overcrowding. But "it's not as tough as it sounds," said Larry M. Eisenberg, '74 (no relation to the Dean), and it all works out to be "an interesting experience in what living is all about." Coed living, too, is "nothing but for the better," he said—a real improvement because you "get to see a woman as a person."

It's a busy campus—160 events every week in the Student Center, said James A. Moody, '75, "and I might have time to go to two of them—astonishing!" Even now, he said, it's "almost impossible" to find a free data for a weekend next year in the Kresge Auditorium schedule. And whenever you go into the Student Center something's going on—meetings, dance groups . . . "they'll drag you right in out of the hall."

What of the future?

Dean Eisenberg demurred. No one could have predicted the unrest of the 1960s, she said, and it's hard now to say what social and economic conditions will be like in the next decade, or how students will respond to them.

For the present everyone is concerned with change—and students are devoted to making changes "within the system, changes which can result from their growing technical competence." But other changes, beyond their control, are also taking place. Young people are maturing earlier; but, because of the increasingly complex education which they need, their chance to fulfill their societal responsibilities is coming later and later.

And more people are in college; and the price of that, said Dean Eisenberg, is more bureaucracy, larger uncertainties, more competition. "Students face a reality that is sometimes threatening," she said, and an example of the problem is her own frustration: "It hurts me that I cannot know everyone."

Blacks at M.I.T.: A New Era and Their Own Alumni Goals

When William Strickland, Professor of Afro-American Studies at the University of Massachusetts in Amherst, walked onto the M.I.T. campus on April 19 seeking the Black Students Conference on Science and Technology, his eyes were assaulted by frisbees and a pie-eating contest (part of the Kaleidoscope, spring

weekend), his ears by rock-and-roll from WTBS "on location" and by selections from "A Funny Thing Happened On the Way to the Forum" on the Student Center steps.

He thought this contrast symbolic of the larger issues to which the Conference was devoted, he said. The trouble is that blacks have "been sitting it out, as if on the balcony of a Southern theater, watching a white drama unfold." But the "real people today are changing history," and that, he told more than 250 students, alumni, and fellow-confererees, is the role which blacks must find for themselves. Science is foremost among the tools of those who would achieve independence and equality. It will be a science not for "the destruction and fragmentation of mankind" but for its true liberation.

To hear the old black songs—his people's heritage—sung by M.I.T.'s Black Christian Fellowship Choir was to Professor Strickland exciting, even astonishing. The beginning of a new era, he thought.

Less astonishing to Ernest Cohen, '64, of the Foxboro Co., who reported that among M.I.T.'s 35,000 graduates are now more than 250 blacks, and more coming every year. What about bringing them together in an association to promote blacks' interests in science and black enrollment at the Institute? They have a powerful leverage, thought Mr. Cohen: the average black graduate earns at least \$12,000 a year—a total earning capacity of \$3 million among the 250 potential members of a black alumni association. An impressive figure, said Mr. Cohen, and he asked his audience to leave behind a questionnaire on which they had indicated their priorities among six possible goals:

—Additional scholarship and loan funds to black students at M.I.T.

—Help for blacks so as to improve their academic successes at M.I.T.

—Encourage blacks to consider careers in science, and to attend M.I.T.

—Study the implications of technology for the "black experience"—the special uses of technology for the underprivileged, for example, or how blacks see science in an image very different from that of whites.

—Special support for such campus activities as the Black Student Union.

—Projects "to aid the professional development and well-being of black M.I.T. alumni."

M.I.T. On the Tube: A Weekly Television Report by MITV

If you want to know what's going on at M.I.T., you can listen to WTBS every evening; you can pick up *Tech Talk* (the official weekly newspaper) on Wednesdays, *The Tech* on Tuesdays and Fridays, this journal eight times a year, *Thursday* on Thursdays, *Monday* on occasional Mondays . . .

. . . or, this spring, you can go to the lobby of Building 7 any time between 9 and 3 on Fridays to watch the weekly report by MITV.

It all began last fall when Craig W. Reynolds, '75, and David L. Olive, '76, brought together some 35 people to dis-

cuss ideas for a television news service. At that point, in addition to the dream in Reynolds' eye, MITV had the promise of a black-and-white studio in the Center for Advanced Engineering Study and of help from Edwin Diamond, former Senior Editor of *Newsweek* who is now Lecturer in Political Science. A few months later the Council for the Arts made a \$2,000 grant to MITV—enough to buy a portable video-tape recorder camera—and on March 15 came the first show, which included:

A report on coed housing, an interview with James R. Killian, Jr., '26, Honorary Chairman of the M.I.T. Corporation, about his years as President Eisenhower's Science Adviser, a short review of national affairs, an excerpt from Daniel Ellsberg's speech of the preceding week, an update on streaking in Harvard Yard, and a look at M.I.T.'s fencing team in action.

That's typical of the 20-minute newscast which appears in Building 7—on a continuous showing basis—every Friday. Paul E. Schindler, Jr., '74, is the anchorman; but there are lots of special reports by others and plenty of pieces from tapes shot during the week—a lively show.

When he started thinking about MITV last fall, Mr. Reynolds said he thought it "would differ philosophically from every news organization now in existence on the campus except for WTBS. There is a real difference, in terms of participation and excitement, between an electronic presentation and a print one.

"There are a lot of electrical engineers at M.I.T.," Mr. Reynolds noted, "and we'll offer them hands-on television experience and a chance to solve some of our problems."

Long-range plans call for a cable connection to various viewing points throughout the campus—and even longer range plans call for shows twice a week—"but that probably won't happen for a long time," says Michael Thomas, '75. Meantime, everyone is busy putting together the weekly tape: "We try to keep it unstructured," says Mr. Thomas, "so everyone has a chance to do what he wants to"—an educational experience. "We won't have it down to routine for a long time."

The tape of MITV's first weekly news report was given to President Jerome B. Wiesner this spring by a collection of people who had parts in making possible the Institute's first television news: from left to right William Roberts, Audio-Visual Engineer at the Center for Advanced Engineering Study; Edwin Diamond, Lecturer in Political Science; Craig Reynolds, '75, Chairman of MITV; and (right) Wilbur B. Davenport, Jr., Sc.D.'50, Director of C.A.E.S. The center picture shows Paul E. Schindler, Jr., '74, who is MITV's anchorman, interviewing Professor Harold E. Edgerton, Sc.D.'31, for a spot on the weekly show, and in the bottom picture Mr. Schindler is on the air in C.A.E.S.'s studio. (Photos: Richard Reihl, '77, David H. Green, '76, from *The Tech*, and Thomas Klimowicz, '77, from *The Tech*)





C. W. Hagge



W. H. Matthews



M. L. Minsky



F. M. M. Morel



S. A. Papert



R. W. Mann

The Environmental Engineer Is Here; Can He Save \$1 Million?

Can one man's ideas and expertise save M.I.T. \$1 million?

That prospect was held out this spring by Thomas E. Shepherd, Jr., '50, Superintendent of Utilities, when he talked with Robert H. Halstead, '75, of *The Tech* about the Institute's search for an Environmental Engineer to direct the energy conservation program.

Now the man for the job has been found, and the moment of truth is approaching for Carl W. Hagge, '58.

Mr. Hagge joined M.I.T. in April, and he's now assumed responsibility for maintaining and enhancing the Institute's effort to save energy and to use it more efficiently. He'll also be in charge of the Institute's compliance with environmental requirements.

Mr. Hagge worked with Edgerton, Germeshausen, and Grier, Inc., the Smithsonian Astrophysical Observatory, and American Science and Engineering, Inc., in various space science and instrumentation assignments from 1958 until 1970, when he entered the field of real estate and income property management. He graduated from M.I.T. in Electrical Engineering.

Mr. Hagge's first year's salary at M.I.T. will be paid by a grant from the Union Pacific Foundation; the Foundation's purpose is to help the Institute—and through it other institutions as well—protect their financial resources by finding ways of limiting expenditures for energy.

Perhaps Mr. Hagge's first challenge to fulfill that purpose will be in connection with this summer's air conditioning demands. M.I.T. will operate its central air conditioners for designed temperatures of 80° to 82° instead of the usual 75°, and it will ask workers who have individual air conditioners to use them as little as possible, opening windows instead. Indeed, Mr. Shepherd told *The Tech* this spring, the summer air conditioning season "may turn out to be the most critical part of our entire energy conservation effort, considering both energy conservation and cost."

Professorships for Matthews, Minsky, and Morel

Three members of the M.I.T. faculty have been named to distinguished chairs this spring:

—**William H. Matthews**, Ph.D.'70, Assistant Professor of Civil Engineering, has been appointed to the Arthur D. Little Chair in Environmental Sciences and Engineering for one and a half years. The purpose of the Professorship is to "encourage and support younger M.I.T. faculty members in environmental studies of an interdisciplinary nature," and Professor Matthews' work is clearly relevant: bringing together scientific knowledge and societal values in assessment, decision-making, and implementation in environmental problems. He holds degrees in mathematics and electrical engineering from Lamar State College of Technology and in political science (S.M.) and so-

ciotechnological engineering (Ph.D.) from M.I.T.

—**Marvin L. Minsky**, Founder and Co-Director of the Artificial Intelligence Laboratory, has been named to the distinguished chair of Donner Professor of Science. He joins Claude E. Shannon, who is on leave from the Institute as Donner Professor. A pioneer in the development of problem-solving theories and in applications of computers, Dr. Minsky came to the Institute in 1958 as Assistant Professor of Mathematics and became Professor of Electrical Engineering in 1964; he studied at Harvard and Princeton (Ph.D. 1954).

—**Francois M. M. Morel**, Assistant Professor of Civil Engineering, is the first holder of the Henry L. Doherty Chair in Ocean Utilization; in this post for two years, he will continue work on the biochemical processes in coastal waters with particular reference to the effects of human activities. A more complete understanding of these processes would be a major step in coastal management. Professor Morel studied at the California Institute of Technology (Ph.D. 1971) and came to the Institute after two years in the environmental engineering sciences program at Caltech.

A New Green Professorship to an Imaginative Educator

The Cecil and Ida Green Professorship in Education has been established by a gift of Cecil B. ('23) and Mrs. Green of Dallas, Texas. Seymour A. Papert, Co-Director of the Artificial Intelligence Laboratory, is its first holder under a three-year appointment in the Division for Study and Research in Education.

Mr. and Mrs. Green—who are major benefactors of the Institute—say this new gift is intended to encourage innovative education and research in the techniques and processes of learning and teaching. It is the third distinguished chair to be established at the Institute under funds which the Greens have provided; the others are the Cecil H. Green Professorship of Electrical Engineering and the Robert R. Shrock Professorship of Earth and Planetary Sciences. In addition, Mr. and Mrs. Green in the early 1960s provided funds that made possible the construction of the 22-story Cecil and Ida Green Building which houses M.I.T.'s Department of Earth and Planetary Sciences and the Department of Meteorology.

Mr. Green was a co-founder of Geophysical Services, Inc., the predecessor company of Texas Instruments, Inc., of Dallas, a major international electronics firm of which Mr. Green has been a principal officer and director. He has been a member of the M.I.T. Corporation since 1958 and has served on several of its Visiting Committees.

Mrs. Green, who has had a joint interest with her husband in education endeavors, has established numerous fellowships for women, which are administered through the American Association of University Women.

Professor Papert, the new Cecil and Ida Green Professor in Education, also holds an appointment in the Department

of Mathematics as Professor of Applied Mathematics. He holds Ph.D. degrees in mathematics from the University of Witwatersrand and Cambridge University and, before coming to M.I.T. in 1963, spent several years at the University of Geneva with the distinguished child psychologist Jean Piaget and his associates.

Professor Papert has been Co-Director with Professor Marvin L. Minsky of M.I.T.'s Artificial Intelligence Laboratory since 1963, and he is well known for work on new methods of teaching at elementary and high school levels. The most visible result of this work is a new approach to using computers in elementary education developed by a research team (including undergraduate and graduate students) working in the Artificial Intelligence Laboratory.

A New Biomedical Engineering Chair to Robert W. Mann

Robert W. Mann, '50, Professor of Engineering and a pioneer in the field, is the first holder of the Uncas A. Whitaker Professorship in Biomedical Engineering, established at M.I.T. this spring. The chair was made possible by a grant from Uncas A. Whitaker, '23, a Life Member of the M.I.T. Corporation, who is founder and now Chairman of the Board of AMP, Inc. (formerly Aircraft-Marine Products, Inc.). Its establishment, says Walter A. Rosenblith, Provost, draws attention to the growing interest at the Institute in programs of teaching and research relating engineering, biology, and medicine together as biomedical engineering.

Mr. Whitaker has had a long interest in education and research in these areas. He made a major gift to M.I.T. for construction of a new building, which now bears his name, to house work in the life sciences, and he took a major interest in the founding of the M.I.T.-Harvard Joint Program in Health Science and Technology, to whose endowment he was the first contributor. Mr. Whitaker has also been active on the Corporation's Visiting Committees in Biology, Nutrition and Food Science, and the M.I.T. Medical Department.

Professor Mann, who will hold the Whitaker Professorship for five years, has had a distinguished career with two main foci. During his early years he worked on internal power systems for missiles and in related research on solid propellants and turbo-machinery. He also made significant early contributions in the development of computer-aided design.

Since about 1960, however, Professor Mann has directed his activities towards biomedical engineering, in particular to the development and application of rehabilitation technology. As an educator, Professor Mann has contributed to design education and to innovations in the teaching of biomedical engineering. After receiving his Sc. D. degree in 1957, he headed the Systems and Design Division of the Mechanical Engineering Department until 1967; he was Kenneth J. Gerneshausen Professor from 1970 to 1972, and since then he has been Chairman of the Steering Committee of

the Health Sciences and Technology Program in biomaterials science and a member of the Executive Committee of the M.I.T.-Harvard Program in Health Sciences and Technology.

The Mellon Professorship: For Stronger Humanities

A gift of \$750,000 to M.I.T. by the Andrew W. Mellon Foundation will endow the Andrew W. Mellon Professorship in the Humanities.

Nathan M. Pusey, former President of Harvard who now heads the Mellon Foundation, said the award was intended to make possible a professorship which can be used flexibly within the structure of the humanities at M.I.T.; it will not be assigned irrevocably to any one subject or field. It is part of the Foundation's continuing effort "to strengthen the influence of the humanities in the educational programs of . . . the country's stronger independent colleges and universities," Dr. Pusey said.

Howard W. Johnson, Chairman of the M.I.T. Corporation, thinks the Mellon Foundation program "a major contribution to education in science-based universities in the world." The Mellon Professorship will be a major step in an effort now underway to broaden the reach and interrelationships of the humanities with technical curricula at M.I.T.

Nine Visiting Faculty

Nine visiting professors, seven from foreign universities, are now concluding their work at M.I.T. during the spring term.

—**Monni Adams**, art historian and anthropologist, has been with the Visual Arts Group this spring to teach a subject in Aesthetic Anthropology. Dr. Adams has lived with Sumbanese people in Indonesia and has specialized in village arts in Africa and other areas outside the European tradition.

—**Siegmund Fischer**, Visiting Associate Professor in the Department of Biology, is Associate Professor of Physiology at the University of Chile.

—**William R. Hawthorne**, Visiting Professor in the School of Engineering, has been at work on several special projects at the School, including research in the Gas Turbine Laboratory. Dr. Hawthorne is a frequent visitor at M.I.T.; he is a member of the M.I.T. Corporation. One of Britain's distinguished engineers, he is Master of Churchill College of the University of Cambridge, England.

—**Henryk J. Leskiewicz**, Visiting Professor in the Department of Mechanical Engineering, is Head of the Institute of Industrial Automatic Control at the Warsaw Technical University. His work at M.I.T. has been in the field of computer control—the same area in which he worked here as a Research Associate in 1957-58.

—**Alvin Liberman**, Visiting Professor in the Department of Psychology, is associated with the Psychology Department at the University of Connecticut and with the Haskins Laboratories and Yale University.

—**Paul F. Rempp**, Director of Research at the Macromolecular Research Center

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D. Kleppner



W. H. G. Lewin



C. C. Mei



R. C. Merton



B. B. Mikic



R. I. Rotberg



A. J. Silk



A. A. Sonin



S. R. Tannenbaum



D. I. C. Wang



M. L. Weitzman



B. J. Wuensch

in Strasbourg, France, was Visiting Professor in the Department of Chemical Engineering for six weeks ending on May 15. His work at M.I.T. was in the field of polymer chemistry; he is Director of the Division of Polymer Synthesis at the Strasbourg Center.

—**Norburg Schulz**, Professor of Architectural History at the State School of Architecture in Oslo, is concluding classes as a Visiting Professor in the same field at M.I.T.—a subject covering architectural development in the period from 1400 to 1750. Professor Schulz has lectured in many European countries, has been Chairman of the Oslo Association of Architects, and is Editor of the Journal of the Norwegian Architects' League.

—**Gian-Carlo Setti**, Visiting Professor in the Department of Physics, is Chief Astronomer at the University of Bologna observatory in Italy. He has been working and teaching in the M.I.T. Center for Space Research.

—**Hian P. Yap**, Visiting Professor in the Department of Mathematics, was on sabbatical leave from the University of Singapore, where he is Lecturer (professor) in Mathematics.

19 Promotions to the Rank of Professor

Nineteen members of the faculty have been promoted to the rank of professor, effective July 1. They are:

—**Thomas J. Allen**, Ph.D.'66, in the Sloan School of Management. Professor Allen's teaching and research are in the field of organization studies, including the relationship of communication to creativity in research and development organizations. He came to M.I.T. for his master's degree (1963) after undergraduate study at Upsala College.

—**Sow-Hsin Chen**, in the Department of Nuclear Engineering. An expert in nuclear radiations, Professor Chen studied at Taiwan University, Tsing Hua University, the University of Michigan, and McMaster University (Ph.D. 1964) before coming to the Institute.

—**Alan Davison**, in the Department of Chemistry. A graduate of the University of Wales and Imperial College, London (Ph.D. 1962), Professor Davison joined the M.I.T. faculty in 1964 to teach inorganic chemistry, including the first- and second-year subjects in that field.

—**Robert E. Hall**, Ph.D.'67, in the Department of Economics. Professor Hall's teaching is in econometrics and macroeconomic theory; he came to M.I.T. for graduate study from the University of California and joined the faculty upon completing his graduate work.

—**Willard R. Johnson**, in the Department of Political Science. A graduate of the University of California (Los Angeles), Johns Hopkins University, and Harvard (Ph.D. 1965), Professor Johnson joined the faculty in 1964; his teaching is in African politics, philosophy, and political thought.

—**Robert S. Kennedy**, Sc.D.'63, in the Department of Electrical Engineering. Professor Kennedy came to the Institute from the University of Kansas in 1955 to receive two graduate degrees (S.M. 1959 and Sc.D.), and he has become an expert

in the field of optical communication systems.

—**John L. Kinsey**, in the Department of Chemistry. At M.I.T. for 10 years, Dr. Kinsey studied at Rice University (B.A. 1956, Ph.D. 1959); his teaching is in physical chemistry and quantum mechanics.

—**Daniel Kleppner**, in the Department of Physics. A graduate of Williams College, Cambridge University, and Harvard (Ph.D. 1959), Dr. Kleppner came to the Institute as Associate Professor in 1966. His teaching and research are in experimental physics using optical, microwave, and radiofrequency methods.

—**Walter H. G. Lewin**, in the Department of Physics. Professor Lewin came to M.I.T. in 1966 after completing undergraduate and graduate degrees at the University of Delft, Netherlands (Ph.D. 1965); his research is in the field of cosmic rays, and he has been responsible for a number of spectacular balloon flights carrying detection equipment over the South Pacific area.

—**Chiang C. Mei**, in the Department of Civil Engineering. Dr. Mei came to Stanford University (M.S. 1958) after completing undergraduate work at Taiwan University; he also holds the Ph.D. from California Institute of Technology (1963). His teaching and research are in hydrodynamics and coastal engineering.

—**Robert C. Merion**, Ph.D.'70, in the Sloan School of Management. A specialist in the theory of capital markets and in financial administration, Dr. Merton studied at Columbia University and the California Institute of Technology before coming to M.I.T. in 1967.

—**Borivoje B. Mikic**, Sc.D.'67, in the Department of Mechanical Engineering. Dr. Mikic came to M.I.T. after undergraduate work at the University of Belgrade, Yugoslavia, and joined the faculty as he was completing his doctorate; his professional work is in the field of thermodynamics and heat transfer.

—**Robert I. Rotberg**, in the Departments of Humanities and of Political Science. Professor Rotberg teaches undergraduate and graduate subjects in nationalism and nation-building in Africa and the Caribbean; he studied at Oberlin College, Princeton, and Oxford (Ph.D. 1960) and arrived at M.I.T. as Associate Professor in 1968.

—**Alvin J. Silk**, in the Sloan School of Management. Dr. Silk studied at the University of Western Ontario and Northwestern (Ph.D. 1968) before coming to the Institute as Associate Professor of Management Science; his teaching is in the field of management data analysis and measurement problems.

—**Ain A. Sonin**, in the Department of Mechanical Engineering. Dr. Sonin's three degrees are from the University of Toronto (Ph.D. 1965), and he has been at M.I.T. since completing studies there. His teaching and research are in the field of fluid mechanics.

—**Steven R. Tannenbaum**, '58, in the Department of Nutrition and Food Science. Dr. Tannenbaum (his Ph.D. is also from M.I.T.—in 1962) is teaching food chemistry and toxicology and environmental factors in food quality—including food preservation and distribution sys-

tems in relation to food-borne diseases and nutritional values.

—**Daniel J. C. Wang**, '59, in the Department of Nutrition and Food Science. Professor Wang studied at the University of Pennsylvania (Ph.D. 1963) after completing bachelor's and master's degrees at M.I.T.; his work is in the field of biochemical engineering.

—**Martin L. Weitzman**, Ph.D.'67, in the Department of Economics. Dr. Weitzman joined the faculty in 1972 in the field of economic theory, growth, and planning. His earlier academic work was at Swarthmore College and Stanford University.

—**Bernhardt J. Wuensch**, '55, in the Department of Metallurgy and Materials Science. Following undergraduate work in physics, Dr. Wuensch studied for his doctorate in the field of crystallography, the area in which his work is now concentrated with particular reference to ceramic materials.

New Associate Professors

Thirty young members of the M.I.T. faculty have been advanced to the rank of Associate Professor, effective July 1. The list below shows, for each appointee, his/her undergraduate and graduate institutions, highest degree and date, M.I.T. department, and current field of teaching.

—**Barry A. Blesser**, '64; M.I.T.; Ph.D. 1969; Department of Electrical Engineering; electronics, instrumentation, and audio-frequency communications.

—**H. Kent Bowen**, Sc.D.'70; University of Utah, M.I.T.; Department of Metallurgy and Materials Science; thermodynamics and kinetics of materials, electrical and optical properties of ceramics.

—**Chrysostomos Chrysostomidis**, Ph.D. '70; Kings College (Oxford), M.I.T.; Department of Ocean Engineering; ocean engineering systems and ship design.

—**Catherine V. Chvany**; Radcliffe, Harvard; Ph.D. 1970; Department of Foreign Literatures and Linguistics; intermediate and advanced Russian.

—**Harry S. Colburn**, '63; M.I.T.; Ph.D. 1969; Department of Electrical Engineering; human and animal auditory systems and communications.

—**Charles C. Counselman**, '64; M.I.T.; Ph.D. 1969; Department of Earth and Planetary Sciences; planetary physics and radio astronomy.

—**Renwick E. Curry**, Ph.D.'68; Middlebury, M.I.T.; Department of Aeronautics and Astronautics; instrumentation and control.

—**Robert F. Engle, III**; Williams, Cornell; Ph.D. 1969; Department of Economics; statistical methods and econometrics.

—**Stephen Erdelyi**; Franz Josef University, Franz Liszt Academy (Hungary), Western Reserve; Ph.D. 1962; music.

—**Clifton G. Fonstad**, Ph.D.'70; University of Wisconsin, M.I.T.; Department of Electrical Engineering; solid state and semiconductor devices.

—**E. Victor George**, Ph.D.'69; Illinois Institute of Technology, M.I.T.; Department of Physics; plasma and laser physics.

—**Jochen Heisenberg**; University of Hamburg (Germany); Ph.D. 1967; Department of Physics; nuclear and particle physics.

—**Joel A. Huberman**; Harvard, California Institute of Technology; Ph.D. 1968; De-

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These three musicians are at work in M.I.T.'s new Center for Asian Music: Afseneh Najmabadi, who teaches the Persian santur, in the foreground; Robert Greer, '74, whose majors are in music

and electrical engineering and who serves as technical assistant for the Center; and William T. Byrd, '74, whose major is in Course XXI-B—Humanities and Science.

partment of Biology; chromosome structure and replication.

—**Jonathan A. King**, Yale, California Institute of Technology; Ph.D. 1967; Department of Biology; biological functions and macromolecular structure.

—**Heather N. Lechtman**, Vassar, New York University; M.A. 1966; Departments of Humanities and of Metallurgy and Materials Science; archeology, ancient technologies, and materials and culture.

—**Margaret L. A. MacVicar**, '64; M.I.T.; Sc.D. 1967; Department of Physics (Class of 1922 Professorship and Director of the Undergraduate Research Opportunities Program); quantum physics.

—**William H. Matthews**, Ph.D.'70; Lamar State College of Technology, M.I.T.; Department of Civil Engineering (Arthur D. Little Professorship of Environmental Sciences and Engineering); engineering and public policy.

—**Amadeo R. Odoni**, '65; M.I.T.; Ph.D. 1969; Department of Aeronautics and Astronautics; air traffic control, air transportation, and urban service systems.

—**Wayne M. Pecknold**, Ph.D.'70; Michigan State University, M.I.T.; Department of Civil Engineering; transportation systems analysis.

—**William M. Rand**; Indiana University, Brandeis, University of California (Los Angeles); Ph.D. 1969; Department of Nutrition and Food Science; biostatistics and mathematical ecology.

—**David G. Schaeffer**, Ph.D.'68; University of Illinois, M.I.T.; Department of Mathematics; differential equations and

generalized functions.

—**William J. Shack**, '64; M.I.T., University of California (Berkeley); Ph.D. 1970; Department of Mechanical Engineering; mechanics of solids.

—**Lawrence E. Susskind**, Ph.D.'73; Columbia, M.I.T.; Department of Urban Studies and Planning (Director of the Undergraduate Urban Studies Program); urban problems and planning processes.

—**Robert J. Taylor**; San Diego State College, University of California (Los Angeles); Ph.D. 1970; Department of Physics.

—**Ian D. Turner**; Harvard; Ph.D. 1972; Department of Urban Studies and Planning; low-income and self-help housing.

—**Philip Thullen**, Sc.D.'69; Purdue, M.I.T.; Department of Mechanical Engineering.

—**Richard C. Tremaglio**, B.Arch.'68; Brown, M.I.T.; Department of Architecture; architectural design.

—**Barry L. Vercoe**; University of Auckland (New Zealand), University of Michigan; A.Mus.D. 1968; Department of Humanities; music theory, computer applications, and electronic music.

—**Judith G. Wechsler**; Brandeis, Columbia, University of California (Los Angeles); Ph.D. 1972; Department of Architecture; history of art, art, culture, and technology.

—**James H. Williams, Jr.**, '67; M.I.T., Cambridge University (England); Ph.D. 1970; Department of Mechanical Engineering (Edgerton Professorship); dynamics and mechanics of solids.

New Experiences in Sound: Santur and Sitar at M.I.T.

Sounds of the santur, the kayagum, and the sitar at M.I.T.? Indeed.

They are Persian, Korean, and Indian instruments, and they are now being played and taught in a new Center for Asian Music which opened this spring.

The Center, established by Donald Sur, Assistant Professor of Music, brings together a wide range of M.I.T. activities related to non-Western music—including concerts, lectures, dance programs and, Professor Sur says, work in his class in Non-Western Music (21.883).

Rooms in Building 20 have been renovated to provide the proper atmosphere for the study and performance of Asian music—wall hangings and floor coverings donated by Spectrum-India of Boston and a Turkish galim (a carpet) loaned by Arthur T. Gregorian of Newton.

But the Center's considerable musical assets are more important. They include three musicians—representatives of traditional Persian, Korean, and Indian musical cultures who are visiting artists this term and will give demonstrations of exotic musical systems, instruct students, perform in concert, and also be available for research projects:

—Afseneh Najmabadi, a graduate student in particle physics at Harvard, teaches Persian music. She plays the santur, a trapezoidal, zither-like instrument that is an ancestor of the piano.

—Yoo-Jin Chung, Research Associate in Music at Harvard, sings traditional Korean opera and plays the kayagum, another zither-type instrument which is related to the Japanese koto and traditionally accompanied by a drum, called a chang-go.

—Sudesh Arora, who teaches Indian music at Brown University, plays and teaches the sitar, a plucked lute.

The Center has found a sympathetic resonance in the Asian community and throughout Greater Boston in general, Professor Sur says. Instruments are on loan to the Center from private collections; in addition to the contributions of furnishings, the Center has an eminent group of honorary advisors.

Professor Sur, who composes in the Western tradition, is himself a specialist in Korean court music. He directed the ethnomusicological program at the State University of New York at Purchase (N.Y.) in 1972-73 and this year was named to the Asia Society's Advisory Committee on the Performing Arts. The idea of the M.I.T. project, he says, is simply to add another dimension to the experiences of students and other members of the Institute community.

"Really Quite Remarkable for Its Depth and Feeling . . ."

Nothing as ambitious as last year's transcontinental tour, but the M.I.T. Symphony Orchestra under the direction of David M. Epstein, Professor of Music, made an international trip to play three concerts in upstate New York and Canada during the March mid-term break. The concerts were marked by large and enthusiastic audiences and praise from area music

critics. The following review by Thomas Putnam in the Buffalo (N.Y.) Courier-Express March 28 following the Buffalo concert on the previous day is typical.

It is only natural that besides science and technology the students of the Massachusetts Institute of Technology should show an aptitude for the chemistry of tones.

Filling the stage of Kleinhans Music Hall with more than 100 players, the M.I.T. Symphony Orchestra under its energetic and persuasive music director David Epstein played a concert Wednesday night that was really quite remarkable for its depth and feeling.

The young musicians were here as guests of the University of Buffalo Music Department.

The evening amply demonstrated new depth in the musical branch of the humanities. John Harbison, a faculty composer, was represented by his Incidental Music for Shakespeare's "Merchant of Venice," which utilizes a string orchestra for music of strained, dramatic expression.

Marcus Thompson, a young and impressive violist who is on the M.I.T. faculty, was soloist for Bloch's "Suite Hebraique," which he played with a lovely singing tone. It was a clean and light performance, not at all cloying.

The Orchestra passed the real test of musical commitment in its performance of Mahler's Symphony No. 1, which Epstein shaped beautifully. The music sounded with shining warmth, lilt, and power which belied the amateur status of the source.

Rubber Bands, Tongue Depressors, and Paper Clips as Engineering Materials

At least twice this spring, M.I.T. students were asked to make something out of almost nothing, and to pit their devices against those of their colleagues.

Students in Professor David G. Wilson's class in Mechanical Engineering Synthesis and Design found their contest a proving ground for their principal goal—to design and build a device to perform a specific task.

The task in this instance was to deliver a glass marble from an elevated starting enclosure to a high-numbered gate on a water trough (hence the name, Watergate Contest) in the shortest possible time.

To build his device, each student received a package of materials—including two large rubber bands, five large paper clips, six inches of piano wire, four tongue depressors, four feet of string, a plastic cup, ten soda straws, a pink eraser, ten pins and, of course a glass marble.

The test apparatus consisted of an overhead wire stretching from above the starting enclosure to the water trough. Most students opted for some sort of pulley system. A few tried catapulting the marbles with sling-shot designs. Some sent off small marble-carrying satellite devices from the main device.

Some seem to have used nearly all the materials provided, others just a few. But—an important lesson, probably—the

simpler devices seemed to do best, or at least to hide their failures better. Some of the more complicated marble-carrying machines—looking like Rube Goldberg contraptions—suffered spectacular disasters, either failing to leave the starting gate at all or falling apart soon after.

Some of the machines fizzled even though they had worked in practice runs—evidence, thought Professor Wilson, of the continuing validity of Murphy's law, which sets out that if something can go wrong, it will.

The task given the students had "all the components of a true design problem," said Professor Wilson. "They had to decide what was the best way to go with the materials they had on hand, and then to come up with an appropriate and practical design."

For most of the 3-½-hour contest, Michael C. Bura, '75, held the lead with a score of 953.04—out of a possible 1140. This meant he had delivered his marble to the highest-numbered starting gate, 76, in 2.46 seconds.

His design was the simplest of all, consisting of a large paper clip, a three-inch length of piano wire, a three-inch square piece of Masonite, a ⅜ inch dowel and some thread.

A late finisher finally edged him out: Thomas S. Birney, '76, who achieved a score of 982.68 on his second run, sending the marble into Gate 76 in 2.07 seconds.

Mr. Birney's simple device, like Mr. Bura's, operated on the pulley principle using only some pieces of a straw, a paper clip, some cardboard tubing and Masonite board, sand as a weight, and thread. He spent about three hours constructing the device and 15 hours testing it.

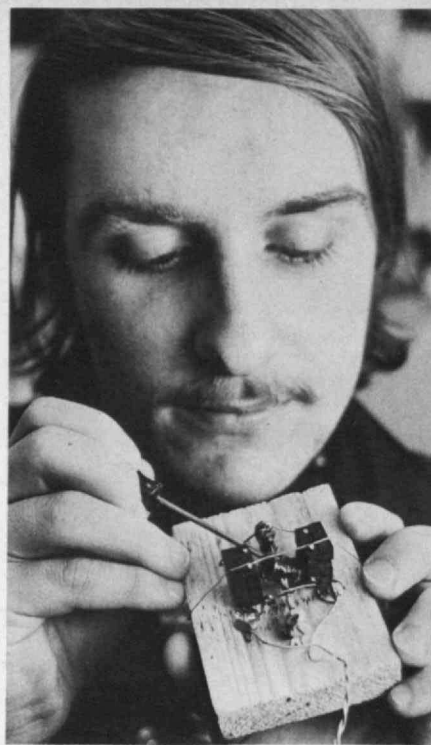
600 Students, 60 Motors

A somewhat different approach with the same theme was used by Professors Michael S. Feld and Wit Busza in second-term physics (8.02). Nearly 600 students were asked to try to build an electric motor with only two paper clips, a piece of wire, two light-weight magnets, and a sewing needle.

Most of them tried it—and most found the task harder than expected. The winner was Ward Harriman, '77, who used the sewing needle as the shaft of the motor and soldered two thumb tacks at right angles to the shaft, their points opposite each other. The tacks became the armature of the motor.

For a commutator Mr. Harriman used the two magnets, which are the flexible kind commonly used by the telephone company to fasten junction boxes to metal desks.

"I cut the magnets in half and used them doubled up," Mr. Harriman said. "I knew that would increase the magnetic field and thereby the torque, and hopefully the speed." It worked. Mr. Harriman's tiny motor, dwarfed by its cigarette-pack-size wooden base, operated at 10,000 revolutions per minute, by far the fastest of some 60 motors that made it to the testing bench for the contest.



This little motor, constructed by Ward Harriman, '77, was the fastest (10,000 r.p.m.) of 60 built by students in second-term physics (8.02) this year. Nothing so unusual about that—except that the motor was built out of such materials as paper clips, thumb tacks, and a sewing needle.

Grants for Materials, Dial-a-Ride, Ocean Teaching, and Cancer

Six grants for research and teaching at M.I.T. have been announced this spring: —\$1,700,000 from the National Science Foundation for continued support of M.I.T.'s Center for Materials Science and Engineering for the year beginning July 1. It is part of the Science Foundation's program to support materials research activities at 14 universities; the grants ranged in size from \$1.9 million for Cornell University to \$225,200 for the University of Massachusetts. The goal is to support interdisciplinary work that would be "difficult or impossible to carry out under the more traditional individual research project funding," says N.S.F.

—\$150,000 from the Department of Transportation to provide research on control procedures for "dial-a-ride" (demand-responsive) transportation systems and for "dual-mode" systems incorporating demand-responsive and scheduled transport services. Nigel H. M. Wilson, '67, Associate Professor of Civil Engineering, is chief investigator.

—\$72,908 from the National Science Foundation as part of a program to improve undergraduate education in naval architecture and ocean engineering design. The award is part of a cooperative program which also includes the University of Michigan and the Webb Institute of Naval Architecture—and thus involves the three U.S. institutions that award undergraduate degrees in naval architec-

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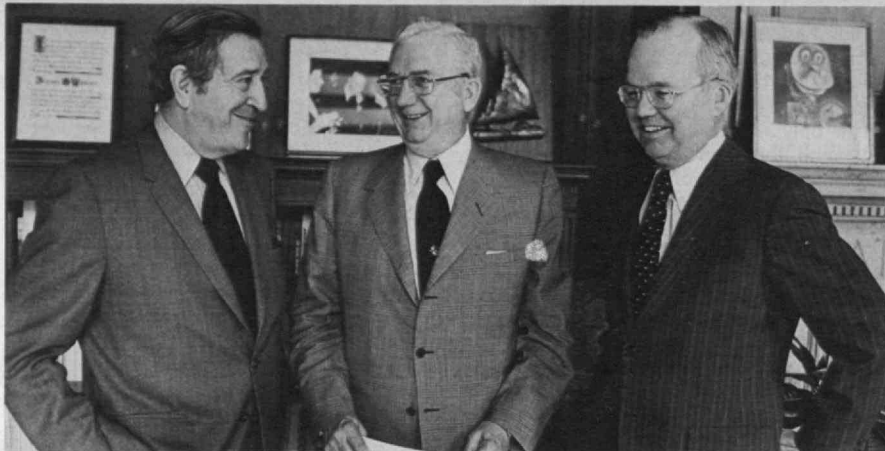
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When Alexander Lewis, Jr., President of the Gulf Oil Foundation, came to Cambridge late in the winter, he was posed for this picture with President Jerome B. Wiesner (left) and Howard W. Johnson (right), Chairman of the Corporation; and then he and two colleagues met at luncheon with M.I.T. faculty members working in energy-related research. Dr.

Lewis' purpose—and the point of the picture—was to deliver a check for \$100,000, a second payment on Gulf's \$250,000 grant to support construction of the Institute's new chemical engineering building. The grant is part of \$2.8 million which Gulf will distribute in 1974 to students and institutions of higher education.

ture.

—\$50,000 from the Fannie E. Rippel Foundation to continue work in the High Voltage Research Laboratory on a new, 3-million-volt electron accelerator for treating certain skin cancers. The grant, providing support for two years, is a continuation of the Foundation's support of a project which began in 1971, and John G. Trump, Sc.D.'33, Director of the Laboratory, thinks the result will be "a clinically attractive instrument which will improve the medical treatment of some very distressing human conditions."

—\$15,950 from the National Science Foundation for a study of energy resource utilization to be undertaken by a team of ten undergraduate students during the coming summer. The work will be under the direction of Charles L. Cooney, '67, Assistant Professor of Nutrition and Food Science.

—\$10,000 from the Council for Tobacco Research to support a fellowship for a graduate student conducting research on the effect of nutrition on lung cancer. The first recipient is Jeffrey N. Clark, who is working with George Wolf, Professor of Physiological Chemistry, on the interaction between vitamin A and cancer.

Measures of Leadership

Four national competitions for fellowships this spring have emphasized M.I.T.'s central role in U.S. education:

—Of 100 fellowships for graduate study awarded by the Danforth Foundation of St. Louis, Mo., to undergraduates throughout the U. S. who are interested in teaching careers, two have come to M.I.T.: David A. Shiang, '74, who will graduate in humanities and science, and Janet E. Stoltz, '74, whose major is in electrical engineering.

—Some 11 per cent of all new graduate students who will hold National Science Foundation Fellowships in 1974-75 will use them to attend M.I.T.—a total of 57

new students. This is more N.S.F. Fellows than will attend any other American university; Stanford is second (55), Harvard third (50).

—Eight of the 78 young scientists who will receive Sloan Research Fellowships from the Alfred P. Sloan Foundation for advanced study and research in 1974-76 are members of the M.I.T. faculty. Those honored for their "capacity to perform outstanding and creative basic research" are: John D. Fenstrom, Assistant Professor of Nutritional Biochemistry and Metabolism; Richard J. Lagow, Assistant Professor of Chemistry; John W. Morgan, Assistant Professor of Mathematics; Bruce R. Patton, Assistant Professor of Physics; Saul A. Rappaport, Ph.D. '68, Associate Professor of Physics; Charles B. Thorn, II, '68, Assistant Professor of Physics; William P. Thurston, Assistant Professor of Mathematics; and Mark S. Wrighton, Assistant Professor of Chemistry.

—The Hertz Foundation has given 30 fellowships, usable at 14 universities including M.I.T., for graduate study in engineering or applied science. Nine of the 30—exactly 30 per cent—Hertz Fellows will use their awards for study at the Institute.

New Sloan Fellows: More Women, More Diversity

Fifty young executives, selected for their promise to become leaders in industry, government, and education, have been named Alfred P. Sloan Fellows for 1974-75. They will study in a special year-long course at the Sloan School of Management starting this month.

Nothing so unusual about that.

But this year's new class of Sloan Fellows breaks precedent in several ways:

—The group includes the largest number of women—five—ever to participate in the nation's oldest executive development program.

—One of these women—Carolyn S. P. Nanfeldt, Financial Analyst in the Treasurer's Office of General Motors Corp.—is the first woman ever nominated for the program by U.S. industry.

—Fellows will come from three government agencies—the U.S. Treasury, the Department of Agriculture, and the Department of Transportation—for the first time in the history of the program.

—One member of the M.I.T. administration, Richard A. Sorenson, Executive Assistant to the Vice President, Operations, will be a Sloan Fellow in 1974-75.

In all, says, Peter P. Gil, Associate Dean of the Sloan School, the 1974-75 Sloan Fellows "represent an increasingly wide and rich variety of backgrounds." Fellows will come from six nations overseas—Brazil, India, Indonesia, Japan, the United Kingdom, and Norway.

Only two M.I.T. alumni are included in the group—John J. Mahoney, S.M. '59, Director of Electronic Systems at the Systems Division of Avco Corp., and Raymond D. Mintz, '54, Staff Assistant in the Office of Regulations and Rulings, U. S. Customs Service.

Art Under the X-ray, and Rembrandts in the Woods

Q: When is a scientist in a museum not like a bull in a china shop?

A: When he is William Young, Director of the Research Laboratory at the Museum of Fine Arts, Boston.

Three goals motivate his work in the museum, Mr. Young told members of the M.I.T. Club of Boston at a dinner meeting this spring:

—To preserve works on display and in storage. A gallery is not an ideal environment for art, thinks Mr. Young, because people just looking at art can be detrimental to it. For example, if a gallery is filled to its capacity of 1,500 viewers for most of a day, as much as 1,500 lbs. of water vapor—and quite a lot of heat—may be added to its atmosphere. Visitors demand good lighting—and that in turn may fade paints and dyes.

—To understand works of art, and determine their authenticity. The popularity of art as an investment medium today has created "a lucrative situation for a forger," says Mr. Young; and it's his job, working with art historians, to understand the materials and techniques by which genuine works can be distinguished from copies. Every field of science is involved: chemistry (analysis, radioactive dating), physics (x-ray diffraction, thermoluminescence, microprobes), biology, and many more. Because "curators get sticky about sampling," Mr. Young has led in the development of nondestructive methods of examination.

—To help restore art, by providing restorers with information about the materials and methods originally used and to devise materials and systems by which to salvage art and fashion repairs.

And then there are the "extracurricular" problems, too. For example, recalled Mr. Young, the project to move many of the Museum of Fine Arts' treasures to distant places for safekeeping during World War II. He recalled his adventures with a truckload of Reubens and Rem-

brandts en route to Williamstown, Mass. At the top of the Mohawk Trail the overheated truck threatened to catch fire, and the result was a gallery of priceless paintings among the roadside trees and shrubs in the village of Florida, Mass.

Open House: 25,000 Balloons, Medallions, but No Parking

People's curiosity about what goes on at M.I.T. was proved once more when between 15,000 and 25,000 turned up on the grey Saturday before Easter for the 1974 Open House.

The biennial event is organized by a student committee to show their families and friends and the public what they find fascinating about the Institute. This year's committee was headed by Charles R. Kenley, a junior in management, who spent most of the spring term getting Open House organized. His work was carried out under Course 15's Undergraduate Studies Program, which allows credit for such large-scale undertakings.

This year's group reached out to several special audiences—with some success.

Invitations to Open House were sent to all students admitted to the Class of 1978, with special letters going to those within a 400-mile radius of M.I.T. Inviting them to spend either Friday or Saturday night in the residence halls. More than 150 of the latter group accepted.

Another special effort was made to attract the families of M.I.T. employees, and this seemed also to have paid off. Everyone from secretaries right through faculty members brought their parents as well as their children.

Almost all exhibits and demonstrations on the main campus were very well attended. Some—like the perennially popular chemistry magic show—were way oversubscribed.

For most of the afternoon the main corridor was harder to traverse than it is at the noon class break. The Building 10 Lobby throbbed with sound from the Logarithms, a rock group, and performances of a modern dance group.

With the help of a campus map included in the program, visitors seemed to adapt well to M.I.T.'s mazelike corridors. Even out-of-the-way demonstrations—such as the chemistry glass-blowing laboratory in the basement of Building 6—drew crowds.

A simulator for Anglo-French Concorde S.S.T. was literally a smashing success in the Department of Aeronautics and Astronautics. Dozens of youngsters tried piloting the simulator all afternoon, and every single one of them crashed. There were, however, no injuries.

Traditional freebies were as popular as ever. Balloons given to children in the main lobby could be heard popping in all corners of the campus. The metal casting laboratory had plenty of takers for M.I.T. medallions, and the Information Processing Center's computer obligingly outputted hundreds of Snoopies.

Only one dissenting voice was heard during the afternoon—a disgruntled graduate student who complained that it had taken him 45 minutes to find a place to park.



Talking computers, exploding chemicals, automatic pilots, rock and roll music, and a host of other sights and sounds greeted M.I.T.'s Open House visitors on April 13. Thinking that "somebody has to keep an eye on those guys," Ed Zuckerman of the Boston Free Press ("underground" newspaper) spent the afternoon doing research for a caustic report on the "other culture": "Wandering through the interconnected numbered corridors for a while gives you an appreciation of the point of view of the laboratory rat. At one point, totally lost, we passed a door marked simply, 'Input.' A few turns of the corridor and we passed a door marked, 'Output.' We speculated whether, if we went back to Input and asked for directions, we would have to race over to Output for the answer." (Photos: Margo Foote)

Individuals Noteworthy

Awards and Honors

David Baltimore, LI'61, the American Cancer Society Professor of Microbiology at M.I.T., has been presented the U.S. Steel Foundation Award in Molecular Biology. . . . **Ernest R. Gilmont**, Ph.D.'56, President of the American Institute of Chemists, was presented the New Jersey Institute of Chemists' Honor Scroll. . . . **Arthur F. Gould**, '38, Lehigh University Alcoa Professor of Industrial Engineering and Chairman in the department of industrial engineering was named "Engineer of the Year", by the Lehigh Valley chapter of the Pennsylvania Society of Professional Engineers. . . . **Salvador E. Luria**, M.I.T. Nobel Laureate in medicine, was awarded the 1974 National Book Award for science as author of *Life: the Unfinished Experiment*. . . . **Kevin Lynch**, '47, of the Department of Urban Studies and Planning has been selected to receive the 1974 Allied Professions Medal of the American Institute of Architects. . . . **Udo J. Strasilla**, E.E.'69, was presented the ETH Silver Medal and a \$500 award by the Swiss Federal Institute of Technology in Zurich for his outstanding Sc.D. thesis. . . . **Harold E. Thayer**, '34, was presented the Missouri Honor Award for Distinguished Service in Engineering by the College of Engineering, Univer-

sity of Missouri-Columbia. . . . **Patrick J. Vayn**, S.M.'69, has been awarded a French Fellowship and **Kenneth P. Wayne**, '72, a Cecil Eaton Fraser Fund Scholarship at the Harvard Business School. . . . **Robert Weinberg**, '64, Assistant Professor of Biology and a researcher in M.I.T.'s Center for Cancer Research, has been awarded a Cancer Research Scholar certificate from the Massachusetts Division of the American Cancer Society. . . . **Irving W. Wilson**, '11, is a recipient of the Metcalf Award, presented by the Engineers' Society of Western Pennsylvania. . . . **Fred Wojtalik**, S.M.'69, has received the "Director's Commendation" for his role in the Skylab space station program of the National Aeronautics and Space Administration.

Rudolf Kalman, '53, has been awarded the Medal of Honor and **John G. Truxal**, '47, the Education Medal, by the Institute of Electrical and Electronics Engineers. . . . **Bradford P. Cross**, '67, and **Howard R. Horvitz**, '68, are recipients of North Atlantic Treaty Organization Postdoctoral Fellowships in Science. This NATO-funded fellowship program is administered by the National Science Foundation.

Corporate Appointments

A. Donald Arsem, '44, has been elected Vice Chairman of the Board of the Wurlitzer Company. . . . Following the merger of American Mail Line Ltd. into American President Lines, Ltd., **Robert E. Benedict**, '44, President of American Mail Line Ltd., will be associated with Everett Steamship Corporation. . . . The Board of Directors of Unifitrode Corporation elected **George M. Berman**, '45, Chairman of the Board. . . . **David A. Grossman**, '51, has been named Director of the financial controls group of the Chase Manhattan Bank. . . . **Vincent P. Healey**, S.M.'49, has joined EDO Corporation as General Manager of the company's Washington office. . . . **Bruce A. Hopkins**, '64, has been elected a Vice President of Hamilton Allied Corporation. . . . **Wesley A. Kuhr**, '39, has been named Corporate Vice President of United Aircraft Corporation. . . . **Robert C. Luscomb, Jr.**, S.M.'70, has been named Director of Production Engineering, sheet metal and plastics, in Oldsmobile's manufacturing department. . . . **Carl D. Peterson**, S.M. '72, has been elected Vice President of Berol Corporation. . . . **David V. Ragone**, '51, has been elected a Director of the Sprague Electric Company. . . . **O. C. Roddey**, S.M.'51, has been promoted to Senior Vice President and Manager of Ralph M. Parsons Company's domestic petroleum-chemical division. . . . **George R. Roy**, '52, has joined Wilbur Smith and Associates, transportation consultants. . . . **Thomas R. Williams**, S.M.'54, has been reelected a Director of National Life Insurance Company of Vermont.

Arthur D. Little, Inc. has announced two appointments: **Gordon Raisbeck**, Ph.D.'49, and **Alfred E. Wechsler**, '55, have been named Corporate Vice Presidents. . . . **John A. Long**, '33, has been named Chairman and Chief Executive of-

ficer, and **Harold Oltobri**, '48, has been named President and Chief Operating officer, of Metallized Ceramics Corp. . . . **Marshall W. Roberts**, '40, has been named Vice President and Assistant to the President of Combustion Engineering, Inc.'s Power Systems Group. . . . **Robert H. Wolin**, '37, has been appointed Combustion Engineering Inc.'s Vice President of Engineering for Fossil Power Systems.

Professional Societies

Vera Kistiakowsky, M.I.T. Professor of Physics, has been elected to the Council of the American Physical Society. . . .

Louis F. Coffin, Jr., Sc.D.'49, delivered the James Clayton Memorial Lecture at the international conference of the Institution of Mechanical Engineers in London, England. . . . **Daniel J. Fink**, '48, has been elected to the National Academy of Engineering in recognition of his "contributions to aeronautics and space in government and in private industry." . . . **Amos E. Joel, Jr.**, '40, has been elected President of the Institute of Electrical and Electronics Engineers Communications Society.

Daniel B. DeBra, S.M.'53, and **Rocco A. Petrone**, '32, have been elected Fellows of the American Institute of Aeronautics and Astronautics. . . . **Robert C. Seamans, Jr.**, '42, has been reelected President of the National Academy of Engineering. . . . **Robert C. Guinness**, '34, has been elected to the Academy's Council. . . . The Institute of Electrical and Electronics Engineers has conferred the grade of Fellow upon the following members: **C. Gordon Bell**, '56, **Leon O. Chua**, S.M.'62, **Andrew F. Corry**, '44, **Thomas M. Cover**, '60, **Robert D. Cutkowsky**, '55, **F. Paul DeMello**, '47, **Edgar N. Gilbert**, Ph.D.'48, **John J. Guarrera**, '43, **Irwin M. Jacobs**, Sc.D.'57, **Frederick Jelinek**, '56, **George C. Maling, Jr.**, '22, **Myron H. Nichols**, Ph.D.'39, **Kendall Preston, Jr.**, '21, **James B. Reswick**, '43, **Leon J. Ricardi**, E.E.'54, **David J. Sakrison**, Sc.D. '61, **Amarjit Singh**, S.E.'61, **Harry L. Van Trees**, Sc.D.'61, **Lawrence J. Varnerin, Jr.**, '44, **George W. Walsh**, S.M.'57, **Shmouel Winograd**, '58.

Special Appointments

James R. Killian, Jr., '26, is heading an *ad hoc* committee convened by the National Academy of Sciences to study the relationship between science and government. Also on the committee are **James B. Fisk**, '31, and **Robert C. Guinness**, '34. . . . **Rexford A. Bristol**, '26, has been named to the Board of Advisors for the College Mental Health Center of Boston, Inc. . . . **Arthur B. Clifton**, marine liaison officer for the M.I.T. Sea Grant Program, has been appointed to a seven-man commission to study the possibility of creating artificial reefs in Massachusetts waters. . . . **Elvin R. Heiberg**, S.M.'58, has been named district engineer for the New Orleans District of the U.S. Army Corps of Engineers. . . . **Richard S. Morse**, '33, has been named to the Commerce Technical Advisory Board of the U.S. Department of Commerce. . . . **Rocco A. Petrone**, '32, has been named Associate Administrator of

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A. T. Ippen

W. G. Whitman

the National Aeronautics and Space Administration. . . . **Ralph Ragan**, S.M.'52, of the Charles Stark Draper Laboratory, has been reappointed Editor-in-Chief of *Journal of Aircraft*. . . . **John G. Trump**, '33, has been elected Chairman of the Board of Trustees of the Lahey Clinic Foundation of Boston. . . . **Reece H. Wengenroth**, '42, has been named to the Jury of Awards for the American Institute of Steel Construction's prize bridges competition.

Walter G. Whitman, 1895-1974

Walter G. Whitman, '17, Professor Emeritus of Chemical Engineering who had also been a science advisor to the United States and to the United Nations, died on April 6 at his retirement home in Scottsdale, Ariz. He was 78.

Professor Whitman, widely known as an educator and leader in chemical research, was Head of the Department of Chemical Engineering at M.I.T. from 1934 until 1961. He officially retired that year while on a leave of absence from the Institute.

He had been appointed Science Advisor by Secretary of State Christian A. Herter in 1960, and he continued in the post during the Kennedy administration until June, 1962.

Earlier, in 1948, Professor Whitman had been Director of the Lexington Project for the Atomic Energy Commission, a study by a group of scientists into the possibility of nuclear propulsion for aircraft, and he had served on the Atomic Energy Commission's General Advisory Committee from 1950 to 1956. It was while a member of this committee that Professor Whitman was selected by Dag Hammarskjöld, then Secretary-General of the United Nations, to organize and head the first international scientific conference, held in Geneva in 1955, on atomic energy and its peaceful uses. Professor Whitman had been Chairman of the Research and Development Board of the Department of Defense and a member of the National Advisory Committee for Aeronautics from 1951 to 1953.

Professor Whitman had recently undergone major surgery; his election to membership in the National Academy of Engineering (for "contributions to chemical engineering and leadership in providing technical advice to the U.S. gov-

ernment and to the United Nations") was announced six days before his death. In a memorial statement, President Jerome B. Wiesner said "Walter Whitman's most notable characteristic was his search for harmony among his fellow men. He set high standards for himself and his colleagues in all that he did."

Professor Whitman joined the Institute staff as an assistant in industrial chemistry upon receiving his bachelor's degree and was promoted to instructor the following year. In 1920, when he completed a master's degree, he was named Assistant Professor of Chemical Engineering, and he served as Assistant Director of the Research Laboratory of Applied Chemistry from 1922 to 1925. He then joined Standard Oil Co. (Indiana) to take responsible posts in research administration, returning to M.I.T. in 1934 to head the Chemical Engineering Department.

Professor Whitman's professional contributions included important discoveries in the fields of corrosion and absorption of gases by liquids; he was also distinguished for research in the field of petroleum refining. He was an Honorary Member of the American Institute of Chemists and held honorary degrees from Northeastern University, Central College, and the University of Pennsylvania.

Arthur T. Ippen, 1907-1974

Arthur T. Ippen, Institute Professor, Emeritus, who was distinguished for contributions to hydraulics and hydrodynamics and beloved as a teacher and counselor, died April 5, at his home of an apparent heart attack. He was 66.

Professor Ippen served as director of the Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics, in the Department of Civil Engineering, until July, 1973, when he retired to become emeritus professor.

President Jerome B. Wiesner called attention to Professor Ippen's "pioneering work in water resource engineering which has benefitted all our lives." And, he said, Professor Ippen will be "deeply missed by his colleagues and students who were lucky enough to know the warmth of a personal relationship with him."

Alfred H. Keil, Dean of the School of Engineering, called attention to Professor Ippen's "towering professional strength and great personal warmth." To his students who now practice and teach all over the world, to his junior colleagues and to all who know him, he was always a personal friend, setting an example of true professionalism and deep personal commitment."

Dr. Ippen's investigations covered a wide range of subjects, including free surface flow, hydraulic machinery, cavitation phenomena, solid-fluid flows, internal flows due to density differences, wave characteristics, turbulence, sedimentation and environmental conditions in coastal waters. He had worked on countless unusual design problems for hydraulic structures, harbors, coastal improvements and environmental investigations.

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1907, Dr. Ippen became a naturalized American citizen in 1945. He studied first at the Technical University of Aachen, Germany, then at the Institute of Hydraulic Research at the University of Iowa, and finally at the California Institute of Technology, where he received a master of science degree in 1935 and the doctorate in 1936.

In 1945 after five years at Lehigh University, Professor Ippen came to M.I.T. as Associate Professor of Hydraulics. He was responsible for the planning and construction of the Institute's first hydrodynamics laboratory, and he served as director until his retirement. It was this laboratory which was enlarged—and renamed the Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics—in 1970 to more adequately house research and teaching activities by more than 60 faculty members and graduate students.

Dr. Ippen was appointed Ford Professor of Engineering in November, 1965, and Institute Professor in June, 1970. At the time Dr. Ippen was appointed Ford Professor, Gordon S. Brown, '31, then Dean of the School of Engineering described him as "one of our most distinguished engineering educators."

Frank T. Westcott

We wish to express our sincere apologies to the family of Frank T. Westcott, '22, for an error which was made in *Technology Review* for May, 1974, reporting his class affiliation as '46.

Deceased

Herbert R. Stearns, '00, February, 1974
 Grant S. Taylor, '02, March 24, 1974*
 Allan H. Barrows, '05, June, 1967
 Harold A. Kingsbury, '07, May, 1969
 Chester N. Moore, '07, June 13, 1970
 C. Frederick Joy, Jr., '08, December 4, 1973
 Arthur F. Mohan, '08, April 6, 1974
 John N. Boyce, '09, January 30, 1974*
 Leander A. Dow, '10, May 16, 1973
 David E. Bartlett, '11, February 5, 1974*
 Morris Omansky, '11, March 30, 1974*
 Ralph S. Pease, '11, March 28, 1971
 Harold L. Robinson, '11, January 5, 1974*
 Richardson Ayres, '12, November 12, 1969
 Lorin G. Miller, '15, May 16, 1966
 Dr. Edward C. Walker, 3rd, '15, February 7, 1974
 James A. Burbank, '16, March 1, 1974*
 Charles A. Abele, '17, September 24, 1972
 Lewis W. Douglas, '17, March 7, 1974
 Professor Walter G. Whitman, '17, April 6, 1974*
 Arthur A. Obert, '18, June 19, 1973
 Walter F. Walworth, '19, January 29, 1974
 Garth C. Boyer, '20, December 22, 1972
 Albert E. Fowler, Jr., '21, December 13, 1973
 Louis J. Caldor, '22, August, 1973
 Charles H. Chadbourn, '22, December 31, 1973
 General William F. Heavey, '22, March 11, 1974
 Albert Kruse, '22, February 1, 1974
 Frank T. Westcott, '22

Harry S. Rubens, '23, February 28, 1974
 Colonel Morris K. Barroll, Jr., '24, August 5, 1969
 James R. Geddes, '25, October, 1973
 Norton C. Swift, '26, December 3, 1973
 Stuart J. Bugbee, '27, February 5, 1974
 George R. Taminosian, '27, January 14, 1974
 Elwood R. Anderson, '28, December, 1973
 Clifford E. Hoar, '30, November 9, 1971
 Jack R. Weprin, '31, February 9, 1974
 G. Fraser Casey, '32, February 20, 1974
 John E. Logan, '33, March 15, 1974
 Edward C. Peterson, '33, February 5, 1974
 Frederick J. Bailey, Jr., '34, January 25, 1974
 Floyd R. Carpenter, '34, January 19, 1974
 Francis E. Cummings, '34, April 11, 1973
 Paul E. Davis, Jr., '35, November 18, 1973
 Samuel T. Orton, Jr., '35, March 30, 1974
 Charles E. Slade, Jr., '35, March 18, 1971
 Mrs. Marion B. Lawson, '36, July 18, 1973
 Webster H. Wilson, '36, April 2, 1974
 Richard E. Leary, '38, June 30, 1970
 John P. Withers, '38, March 22, 1974
 Dr. Chester H. Gordon, '41, March 22, 1973
 Elios D. Cirelli, '45, October 18, 1973
 Richard W. Luce, Jr., '45, January 2, 1974
 Captain Negus W. Knowlton, '46, January 22, 1973
 Dr. Warren J. Kaufman, '47, November, 1973
 Dr. Samuel J. Mason, '47, March 10, 1974
 Walter M. Beckwith, '50, March 1, 1972
 William F. Helmich, Jr., '50, November 23, 1973
 Dr. Peng C. C. Yang, '62, 1972
 * Further information in *Class Review*

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Class Review

96

A spring visit to the Brockton Art Center-Fuller Memorial (**Myron Fuller**, '96) uncovered an experimental program being conducted by the Boston Art Museum and the Art Center. A varied exhibit has been loaned for the entire year and it is the nucleus of a well-planned program for schools in the nearby area. In addition to the obvious advantages for the smaller museum, the larger one is profiting since material which would be in storage is on view, thereby increasing interest in the Boston Museum. This also lessens the educational staff load at the major institution. Other museums are watching this experiment which will probably be repeated next year. In this case the good that one classmate has done for his fellow citizens not only lives on, but increases.—**Clare Driscoll**, Acting Secretary, 2032 Belmont Rd. N.W., Washington, D.C. 20009

98

We regret the passing of classmate **George K. Newbury** on March 11, 1974 in a Hendersonville, North Carolina hospital, after an illness due to a broken hip in February. He would have been 98 years old on March 28. In the December issue you read about the lovely home he had with his daughter, Mrs. Olive N. Buckley, of 210 Morris Lane in Hendersonville, one of the best retirement places in the U.S.

A native of Newbury Park, N.C., he was formerly of Sewickly, Pa., and had lived in Hendersonville for 15 years. At M.I.T. he took Course XIII, Naval Architecture, and graduated in 1898 with a B.S. Later he was a holder of several patents and was associated with Jones and Laughlin Steel Corp. He was the husband of Marian Howe Newbury who died in 1967.

Surviving are his daughter, who kindly wrote to me; four sons, Allan H. Newbury of Oak Hill, W. Va., Russell H. Newbury of Jekyll Island, Ga., Gilbert H. Newbury of Wequetonsing, Mich., and Kenneth H. Newbury of Mont Rose, Wyo.; a brother, Egbert Newbury of Concord, Mass.; 24 grandchildren and 22 great-grandchildren.

In the October-November, 1973 issue there was an obituary in the Class Notes

about **Joseph Cains Riley**, Professor Emeritus. The following is additional information about Professor Riley who became an assistant instructor of mechanical engineering upon graduation in 1898. He was appointed Assistant Professor in 1908, Associate Professor of Heat Engineering in 1912 and was promoted to the rank of professor in 1920.

During World War I, Major Riley served with the technical section of the Service of Supply in the Air Service.

He leaves a sister, Mrs. Rachel R. Chalkley, of Gloucester, Va., and several nieces and nephews.—Mrs. **Audrey Jones Jones**, Acting Secretary, P.O. Box 294, Forest Park Station, Springfield, Mass. 01108

02

Our classmate, **Grant S. Taylor**, died March 24, 1974 in Clearwater, Fla., where he had lived since his retirement. He was a native of Newport, R.I., where he was born May 22, 1880. Taylor was graduated from the naval architecture course but followed that line but little after graduation. He became connected with construction engineering and was for many years with the Turner Construction Co., which specialized in concrete construction. The company had offices in both New York and Boston and Taylor served in both in concrete design. His wife, Susanna Stevens (Sparks) Taylor passed away February 9, 1974.

The Alumni Office reports a change of address for **Chauncey P. Manning**. His new address is: 407 Foulk Rd., Wilmington, Del. 19803. **Burton G. Philbrick**, Secretary, 68 Dane St., Beverly, Mass. 01915

05

Here I am again at my daughter's home in Greensborough, N.C., enjoying the wonderful spring weather and flowers and my family's T.L.C. My son-in-law flew to Boston to take over the burden of baggage, wheel chairs, etc., at airports. All of which means that I have recovered from my "mild paralysis" sufficiently to make the necessary changes with the aid of a cane. Lucky me!

My classmates apparently have had little to write about, or are satisfied with my personals. **Roy Allen** writes that

though living alone, he eats three good meals a day, "two of which I prepare" and takes care of his five-room apartment but adds that "I have concluded that it does not pay to become old."

I have a newsy letter from Hazel Wells (Mrs. **A. Warren Wells**). In the rush of packing for this trip, this letter was left out but I do remember that they have left Florida—Warren to be in a very friendly nursing facility and she to be with nearby relatives. When I get home I will find this letter and report more accurately in the next letter.—**Fred Goldthwait**, Box 231, Center Sandwich, N.H. 03227

08

We regret to report the death of another noted architect, **Edgar I. Williams** (89), who passed away at his home January 1, 1974 in New Milford, Conn.

He had played an influential role in his profession as President of the National Academy of Design, the Architectural League and Municipal Art Society. His views in shaping architectural design in the mid-century were most clearly stated in 1939 when he opened the Architectural League's fall exhibition. The trend, he said, was toward directness of style as against the veneer that predominated earlier.

He lived most of his life in Rutherford, N.J., serving on the Planning Board where he received its first Citizen of the Year Award. He attended schools in Rutherford and Geneva before M.I.T., where he graduated in 1908 and received a master's degree in 1909. The next three years he studied in Rome at the American Academy and earned a fellowship in 1912. On returning to the U.S. he taught at M.I.T.

He was Consulting Architect for the New York Public Library. He redesigned the Central Circulation Branch on Fifth Avenue.

Other work included redesign of Andrew Carnegie mansion for the New York School of Social Work. He served with Richard M. Bennett and Eno Searmen to architecturally improve the new American embassies around the world.

A note from the Alumni Office tells of the death of **C. Fred Joy, Jr.**, a civil engineer of 50 Meredith Circle, Milton, Mass., on December 4, 1973. For the Class we

extend our sympathy to Mrs. Joy.

There is only one change of address to report. **Harry P. Sweeny** is now at 38 Oliver St., Rockland, Maine.—**Joseph W. Wattles**, Secretary, 26 Bullard Rd., Weston, Mass. 02193

09

During the past months we have received almost no news from members of the Class. As stated by **Art Shaw** in his letter of last October, "our numbers dwindle with the passing years". As usual, Art and Betty left last fall to spend the winter at Longboat Key, Sarasota, Fla. He wrote: "We had an interesting trip down in the last week in November, having no severe gas problems and finding it rather pleasant to set the cruising control at 50 m.p.h., as President Nixon then requested. It was relaxing as compared to the usual 65 to 70 and enabled us to see and enjoy the areas through which we were passing. Also, our new Buick gave us over 14 m.p.g. in spite of the gas-guzzling gadgets which are supposed to reduce pollution." Many probably have not realized that 1974 is the 65th anniversary of our graduation. The Secretary has had this in mind during the year and was in doubt as to what form any "reunion" should take. I spoke to John Mattill, Editor of the *Review*. He suggested that we join the Sunday Alumni program of entertainment and buffet supper at the Student Center, then go by buses to the Pops at Symphony Hall. Monday there would be the usual Alumni events followed by the luncheon at noon. Keeping in mind that only four members and wives or guests attended the 1973 Alumni Luncheon, it was decided to limit our reunion to Monday, June 3. However, John Mattill has invited the Class to the usual meeting of Class Secretaries at 11:30 at the Student Center just before the luncheon. Arrangements can be made for those who may desire to attend the Sunday events. (You will have received a class announcement before this *Review* reaches you.)

In the February *Review* we told of the 60th wedding anniversary celebration of Theora and **Phil Chase** which was held last September at Kennebunk Beach, Maine. We were pleased to receive lately a note from Phil enclosing a clipping from the local newspaper giving a more complete account of the event. The clipping, which included a photograph of Phil and Theora, stated that they had received congratulations from Governors Kenneth Curtis of Maine, Francis Sargent of Massachusetts, Rubin Askew of Florida, and William Cahill of New Jersey. The Chases have been summer residents of Kennebunk Beach for many years and a street, Chase's Hill, is named for the family.

Phil's note reads: "We were so pleased to see in the February *Technology Review* your report on our 60th wedding anniversary. Also the background information you included brought back happy memories. The anniversary affair was very exciting with so much activity and so many relatives and friends. The enclosed slip of newspaper items gives



Longtime women's activist Florence Luscomb, '09, addresses lunchtime rally at City Hall Plaza in Boston. The rally was sponsored by 9 to 5, an organization composed of area women office workers,

to mark National Secretaries Week. Supporters aired their grievances and voiced their demands. (Globe photo by Jack O'Connell)

some idea of the events. We missed you and Muriel as we hoped you would come. It was too bad the communication from my nephew reached you too late. We were in Kennebunk Beach from late in May until three days after Christmas, reaching here (Wynnewood, Pa.) almost two months later than usual. The 60th anniversary and some house construction work contributed a little to the delay, but engine replacement in our car accounted for over a month. Finally, bad weather held us back. Consequently, we are still struggling to catch up. Theora joins me in sending best regards."

We have received a notice of the death of **John N. Boyce**, Course II, at Akron, Ohio, on January 30 of this year. He married Gladys Elizabeth Mosher on August 5, 1916. Our records show that most of his life was spent in Lima and Akron, Ohio, and during this period he was employed by the Anaconda Mining Co. . . . Luders and Associates, Architects of Irvington, N.Y., I sent a notice of the death in December, 1973, at Dobbs Ferry, of **Rebecca Hill Thompson**, Course IV. She was born in New Jersey in 1885 but raised in Honolulu where her father was director of the Kamehameha School for Hawaiian Boys. She attended the University of California prior to entering the Institute where she was a member of the Cleofan Society. She was the first woman member of the architectural firm of Carrere and Hastings in New York City, and was a pioneer among women in the field of architecture. She maintained an active practice in Westchester County and designed several houses in the Dobbs Ferry area where she lived for 50 years. She was a member of the Westchester Chap-

ter of the American Institute of Architects.—**Chester L. Dawes**, Secretary, Pierce Hall, Harvard University, Cambridge, Mass. 02138

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Mention was made in the previous issue of the *Review* regarding the death of **Hiram E. Beebe**. Hiram received his B.A. and B.S. degrees from the University of South Dakota, after which he studied at M.I.T., receiving his B.S. degree in electrical engineering. After graduation he returned to Ipswich, S.D., the place of his birth, and became associated, as Vice President, with the Bank of Ipswich. He was a man of varied interests, many of which related to civic activities allied with municipal and state affairs.

In the early 1940's the Beebe family moved to California where they were residing at the time of Hiram's death. During World War II he became associated with Lockheed Aircraft at Burbank, Calif. Following his war work he became established in the Los Angeles and Orange County areas. He held membership in the Southern California M.I.T. Alumni Association. Hiram Beebe married Lucy Valentine, a former teacher in the Ipswich, South Dakota school system. He is survived by his wife and two adopted children, a son and a daughter; also one sister. The sympathy of the surviving classmates is extended to his family.

Earl H. Barber passed away February 9, 1974. He was a former advisor to Massachusetts Public Utilities Commission. He resided in Reading, Mass., for more than 50 years; he was born in

Worcester, Mass. He owned the Barber Engineering Co., of Reading, Mass. During World War II, he served with the Ninth Service Command, negotiating power contracts in the Salt Lake City, Utah area.

He was a member of the American Society of Civil Engineers and the Cosmos Club of Washington, D.C. He is survived by his wife Maude (Skidmore) Barber. The surviving classmates extend sympathy to his family.

Allen A. Gould passed away October 2, 1973. At the time of his death he was Director, Secretary, and Treasurer of the Cleveland Steel Tool Co.

He was born in the Boston area. About a year after his graduation from M.I.T., he took up residence in Cleveland, Ohio, and became an associate with A. A. Gould and Co., and Gould Kramer Co., both concerns being engaged in sales and engineering and also in product development for heavy metal materials. During World War I he served with the army on the Mexican border with Cleveland's Troop A. He was also in the employ of the British Ministry of Munitions. At the end of his military career he held the rank of major.

He was a member of the American Society of Metals, M.I.T. Alumni Affairs Committee, University Club, Cleveland Skating Club, Cavalry Veterans Association and the American Legion. He is survived by his wife Barbara; also a brother and a sister. The sympathy of his classmates is extended to his family.

Recent information received from our faithful 1910 Class Agent, **John B. Babcock 3d**, who is also our permanent Reunion Chairman, indicates that he also is active as Secretary of the M.I.T. Alumni group in the Portland, Maine area. Jack reports that he will soon be active upon initiating plans for our 65th Class Reunion in 1975.

News comes that **Murray H. Mellish** and his wife Eva spent the past fall and winter season in California where their daughter Elise and family are long-time residents. The Mellishes have not yet returned to their permanent address in Malden, Mass. Murray and Eva have customarily spent their winters in California since his retirement about 15 years ago. It has been their practice to return home in time to "summerize" their property and start their extensive gardening work under Eva's supervision.

Last year, for the first time in a good many years, they were unable to attend the M.I.T. Annual Alumni Luncheon during commencement activities. They were particularly missed by your Assistant Secretary and his wife Meta, who proved to be the only representatives of our Class at the 1910 luncheon table. However, two couples from the 50-year class joined us, thereby swelling the attendance at our 1910 table to a grand total of six.

Please note the address for sending your future 1910 Class Notes while our dependable official Secretary **Herb Cleverdon** is somewhat out of circulation.—**Ralph W. Horne**, your Vice President and Acting Assistant Secretary, c/o Fay, Spofford and Thorndike, Inc., 11 Beacon St., Boston, Mass. 02108

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The following came from the Aluminum Company of America: "Two of the world's best known aluminum industry executives, **Irving W. (Chief) Wilson**, retired Chairman of Aluminum Company of America, and **John D. Harper**, incumbent Chairman, today share a new distinction. Both are now recipients of the Metcalf Award, presented annually by the Engineer's Society of Western Pennsylvania to outstanding members of the profession. Mr. Wilson, aluminum's acknowledged 'dean,' and known primarily for implementing Alcoa's tremendous expansion programs before and during World War II, received the honor this month." (February, 1974)

A letter from his daughter-in-law told of the death last January 5 of **Harold L. Robinson**, who, since his wife's death in 1972, had been living with his son, Richard, in Brookfield, Mass. Harold was legally blind for a number of years but in spite of this handicap was one of the few classmates who wrote to me from time to time. That is how he got his name into these Notes six times.

Harold was born in Boston in 1889, went to the Winchester High School and graduated from Tech in civil engineering. He spent most of his working life in the construction business, working for Abertaw and other contractors and later starting a construction company of his own which is still being carried on by his son.

I am sorry to have to report another death. **Morris Omansky** of 9 Babcock St., Brookline, passed away March 28. Morris had been one of the real active members of the Class and was Chairman of the committee for our 55th Reunion. Born in Kiev, Russia, he graduated from the Boston English High School and with us in Course V, chemistry. For many years Morris maintained an office in Cambridge as a consultant in rubber chemistry. He was particularly active as an expert witness in litigation. He had been in ill health for some time and was in a nursing home for several months. He is survived by his wife, Ricca, a son, Samuel I. Omansky and a daughter Mrs. Frieda S. Cohen. I have sent letters of sympathy to both the Robinson and Omansky families.

The third death that I have to report this month is that of **David E. Bartlett** of 236 Olmstead Dr., Titusville, Fla. Dave was born in Lowell, Mass., in 1887, attended the Lowell High School and the electrical engineering course at M.I.T. I am sorry I have no more information about him as he is one of those about whom I have heard nothing since I became Secretary.

I have one address change: **John A. Urquhart**, 875 Elm St., Manchester, N.H.—**Oberlin S. Clark**, Secretary, 50 Leonard Rd., North Weymouth, Mass. 02191

12

Ham Merrill has sent an interesting letter from his new home in Orleans, Mass.,

on Cape Cod, which he says is an ideal retirement spot. He and Phyllis are in good health and most active. About 15 M.I.T. residents, of which he is the senior, meet weekly for general discussions. He has also become interested in the French Cable Museum, the Historical Society, the Orleans Conservation Trust, and Score. The latter agency helps small businesses out of trouble when not too late to seek assistance. Ham is most interested in the project and has ten clients. The Merrills plan a trip to the Canadian Rockies this summer. . . . **Larry Cummings** and **Julie** wrote me, enclosing a clipping stating that the fine old covered bridge in the nearby town of Brownsville, Ind., has been sold at auction and will be placed in a park near Indianapolis, which will save it from destruction. Welcome news. The reservoir which will be built on its site will make fishing possible, which pleases Larry greatly. Both he and Julie are in good health and hope to be able to drive to Squam Lake, N.H., where they usually spend their summers. They had a cold winter in Indiana and Larry is chafing to get out on the golf course. They went to Washington, D.C., in April, where daughter Marion was married. . . .

Jim Cook writes that all is well with him except that his hearing is getting worse. Last fall Jim learned that bluefish, my favorite, were being caught off Marblehead for the first time. He obtained one big bluefish and four flounder which he brought home and cleaned. Jim says a grandson was married in April and the Cooks had a big family reunion. . . . Mrs. **Randall Cremer**, Dorothy, whom many will recall at our 65th Reunion, writes that she attended the 26th annual M.I.T. Mexican Fiesta last March, and that **Johnnie Noyes** was also present. They represented the Class of 1912, which was the earliest class present. There was a large attendance with many parties and interesting meetings in Mexico City, following which everyone enjoyed a three day tour to Oaxaca.

Very belatedly, we are advised of the passing of **Richardson Ayres**, Course I, on November 12, 1969 at Alexandria, La., where he had been engaged in business of his own prior to retirement. No other information is available. He has never contributed to our class news.

We also regret to report the sudden passing of our oldest classmate and only coed, Miss **Hattie Haub** in Sausalito, Calif., on March 20, 1974 due to pneumonia. Hattie was 92 years old, and had been able to get about, and kept the use of all her faculties. She graduated from Stanford University in 1903 and taught for several years, before enrolling in chemistry, Course V, in our Class. After graduation, she returned to California and was Vice Principal of Piedmont High School for many years. She wrote several books on elementary chemistry. In early years she enjoyed hiking and was a world traveller. She had always been very active until limited by an accident several years ago, and she then lived with her niece, Vera Stump.

I am happy to advise that one of my nine grandchildren, Sue Millington, is planning to be married on May 25 to her classmate at Columbia School of Law,

N.Y., where they are both juniors. I have presently five other grandchildren in college or graduated. Personally, I am in reasonably good health living alone in an apartment. Like most of us, the number of daily aches and pains is increasing, but I am thankful that I am able to get about and take my daily walk. I do not enjoy driving alone for any distance.

Individual requests for annual class dues are not being mailed this year, although we shall be glad to have a contribution from any who wish to help. More important, we suggest that you send at least a brief letter advising of your general health and of any activities or news. This will be appreciated by all.—**Ray E. Wilson**, Secretary, 304 Park Ave., Swarthmore, Pa. 19081

13

Again we are watching our last severe snow-storm (we hope). Snow, sleet, and temperatures in the low 20's prevail in our existing spring in coastal Maine. We hope that you have enjoyed our recording of the last three issues of the *Technology Review* featuring several write-ups on the **Ellis Brewsters**, **George Wallace**, and **Marion Rice Hart**.

Again, we were pleased to receive short notes (through the Alumni Fund organization), and we quote **Walter Muther**: "About Christmas time (1973), I fell heir to osteoarthritis of the spine that has taken most of the joy out of life. However, 'We shall overcome.' The best procedure so far has been a daily sauna bath. Try it. Oh, you Finns." . . . We quote from a note by **Edward E. Jewett**: "My activities are so minor that they would be of no interest to my classmates. My home sets about 150 feet from the street, requiring frequent grass cutting in the summer and a heavy duty snow blower during winter. Fishing in front of our house was very good last summer."

We have received a letter from **George Warren Smith**, Secretary of the Class of 1926, and we pass the contents on to you. We searched our records, but we were unable to give him the information he desired. If any of you of 1913 are interested, kindly forward your suggestions to **George W. Smith**, P.O. Box 506, Pigeon Cove, Ma. 01960. We quote: "While writing my Class Notes this morning (and gazing out to sea from my vantage point in Pigeon Cove), it occurs to me that some needed information may be available from my fellow Class Secretaries. Who are the yachting enthusiasts among our alumni? I came up with a dozen or so in our Class and nearby classes. Since yachtsmen seldom keep their sport a secret, it seems likely that you may know of a few alumni in this category. The enclosed self-addressed postcard is for you to use in sending me their names—if you can think of a few. It really will help with some plans we are working up to improve the M.I.T. Sailing Pavilion. Many thanks." . . . A letter has been received from **Richard Knight**, Secretary of the Alumni Association stating that your Secretary and **Frank Achard** would still represent our

Class of 1913 on the Alumni Advisory Council, and that **Henry O. Glidden** and **Ellis W. Brewster** were being added to the nomination list as future members of the Council.

We were very pleased to receive a note from **Mrs. Dick Cross**: "Thank you very much for sending me, on behalf of the Class of 1913, the lovely card of sympathy. It touched me and would, I know, have pleased Dick. He died very quickly and painlessly, for which my thanks are boundless. With appreciation." She enclosed a formal notice of his death and we quote: "The following excerpt from *The Drama of Albert Einstein* by Antonina Vallentin (Doubleday, 1954) epitomizes Dick's religious beliefs. A copy of it has hung above his desk for many years and it was read at our very small family service on February 24, 1974: "'It would be difficult to find a scientific mind which penetrated into the depth of all things and did not have its own religion.' Einstein refused to admit a God who could be reached by prayer or angered by the neglect of some secular rite. But he recognized the existence of a force superior to our petty lives. Einstein calls this superior force that orientates our lives and gives it its superpersonal content, cosmic religion. It is this religion that has taken the place of the ethics of a religion of fear, that has based morality on man's consciousness of the nobility of his aims and on his sense of dignity. 'Science without religion is lame; religion without science is blind.' Religion, as he understands it, reveals on the one hand the immovable laws of the universe and on the other the precariousness of all mortal things. But it also has for him a mysterious element. 'The man who is not familiar with this sense of the mysterious, and who has lost the faculty of wonder and veneration, is a dead man.' Einstein's consciousness of the mysteries grew with the number of new laws of the universe that were revealed to him, the laws that direct the nebulae and the atoms.—Not the personal and revengeful god of his ancestors, but the God of the supreme order of nature, who leaves nothing to chance. 'God is subtle but he is not malicious.'"

Roz and yours truly hope to attend the Homecoming or Alumni Day in June on campus, and we hope to see a sizeable representation from the Class of 1913. So keep us informed of news and plans.—**George Philip Capen**, Secretary and Treasurer, **Rosalind R. Capen**, Assistant Secretary, Granite Point Rd., Biddeford, Maine 04005

14

Though a brief obituary of **Eugenio Garza Sada** appeared on page 109 of the December, 1973 issue of the *Technology Review*, and another in the news of our Class in the issue of last January, additional information received since those notes were written makes good some omissions from the earlier accounts. **Clarence M. Cornish**, '24, provided the following: "It has been said that an institution is but the lengthened shadow

of a man. This is unquestionably true of the Technological Institute of Monterrey, which owes its existence to the energy and rare social vision of the late **Eugenio Garza Sada**. **Eugenio Garza Sada** undoubtedly drew on his experience as a student at M.I.T. when he conceived and directed the establishment of a counterpart technological school to help meet Mexico's rapidly expanding need for qualified technicians. Founding of the Technological Institute of Monterrey was entirely consistent with **Garza Sada's** role as a creator of sources of employment through the vast industrial empire he directed until his tragic death in September, 1973. Established in 1943, the Technological Institute of Monterrey began with some 300 students in its preparatory school and three professional courses. In the space of only three decades the Institute has not only grown in size and scope but has acquired an international reputation for the excellence of its academic instruction as well as its modern physical installations. With a current enrollment of well over 13 thousand, the Institute offers professional studies to students from all over Mexico and from 17 other Spanish-speaking nations. Through June of 1973, the Institute had conferred more than 8000 professional degrees." **Ing. Federico de la Vega**, '53, wrote, in part, "Don **Eugenio** was a spokesman for progress in Latin America, even though he refused to be acknowledged as its principal spokesman. His tireless efforts and stubbornness, rarely equaled, enabled him to lead, as a patriarch, a group of individuals to expand a few modest investments in Monterrey into the largest conglomerate of industry, business and banking in all Latin America. His austerity and humility will always be an inspiration to all who knew of him, for few knew him well in life. Here was a man who never accepted an honor, was shy of publicity and never spoke in public, and yet the immensity of this work, his creativity and his example to youth are an undying inspiration to be—for all of us."

New Address: **Victor J. Galleni**, 216 Pearl St., Newton, Mass. 02158.—**Charles H. Chatfield**, Secretary, 177 Steele Rd., West Hartford, Ct. 06119

15

Many thanks, many blessings to you 73 per cent of our active mailing list who paid your class dues. A remarkable response from the Class Supreme—indeed! This puts our exchequer in sound shape for your underpaid Secretary to plan a trip for himself before that **Jim Tobey** (ah, me!) makes a motion to have the class books audited!

The sad loss of **Ben Neal** posed a hard problem for the class officers and Alumni Association to replace him as Class Agent. No one would or could do the magnificent job **Ben** has done over the years, giving generously of his time, spirit and personal expense. However, his former secretary, **Joyce Brado** of Lockport, New York, who had been associated for years with **Ben** in this work, has kindly and generously agreed to be-

come Class Agent for us. Many of you will be getting her letters. We praise and admire Joyce's willingness, spirit and cooperation to do this for 1915. Many thanks Joyce. With the class dues came some interesting and delightful news bits from our good Class widely scattered over our country. I'll try to give them to you alphabetically.

Congratulations to **Phil Alger** for his honors. The Institute of Electrical and Electronics Engineers gave him a brass plaque on his eightieth birthday. A few days following his birthday a few friends gave him a luncheon at the Engineers Club, together with an ornate electric clock. At the meeting at which he presented his paper an interruption brought forth two cakes with four candles that he blew out. In Schenectady the A.S.M.E. gave him a 50-year pin and certificate, "In honor of his diligent service and unselfish devotion." Phil adds, "My new book is now in the final stages of proof-reading and index preparation. I will send you a copy."

Alice Anderson continues to be the gay widow with her cruises. The past winter she went down the Amazon on an interesting trip. . . . **Larry Bailey** had had his second great-grandson. His son Bob, who comes to our Boston lunches, is with Environmental Research and Technology in Lexington, Mass. . . . **Dick Bailey** has retired to a quiet life in Berwyn, Pa., and is sorry that he has no new stories for us. . . . **Sam Berke** writes, "I am grateful that I am still around and that I don't have too much to complain about physically. I have the usual problems that come with age—not enough to do and after five years of retirement I have developed a streak of laziness that I think I am beginning to enjoy. I stopped traveling in 1972 and am conserving my energy for our 1975 Reunion. See you then."

Wayne Bradley spent the winter roaming all over Florida. On his return here we had a pleasant dinner and evening together. . . . **Bill Brackett** writes, "Now I am going to investigate the possibility of having a new hip joint installed in my left hip and maybe one in my right. The left one had been hurting more than the right one and the left leg has become about one inch shorter due to the erosion. After that is ok I may start to rebuild some other part." . . . **Frank Boynton** says that he keeps busy but has not been travelling because of the gas shortage, old age and poor health. This meant giving up their annual Florida trip this winter. . . . **Marjorie and Whit Brown** are enjoying their quiet retirement to Anna Marie, Fla. . . . **Eves Burtner** tells us, "Settling in a new home (1971) and within a strange town takes time even though our neighbors and townspeople are most kind and friendly. Aside from a two-week visit with our daughter and family a year ago we have kept within a 100-mile radius. Will hope to make the next M.I.T. '15 party." . . . **Orton Capp**, Middlebury, Conn., writes, "I retired from Platt Brothers several years ago but fortunately have some part-time work in which I am very interested. It keeps me busy and active."

"I am home most of the year includ-

ing the winter, but usually do go to Florida for a couple of weeks in the spring. Always enjoy reading the Class Notes. Keep up the good work." . . . Thanks to **Jerry Coldwell**, "I don't know how you do it on such small amounts but you certainly do an excellent job for the Class. No news about myself that you don't already know. There is progress but it is very slow." . . . The old Wolf, **Alton Cook**, Bloomfield, N.J., writes, "Perhaps with another four years, having reached the average age of 85 (if we make it) we can be free loaders—no dues! Incidentally I didn't hear from **Sol Schneider** this Christmas as per usual."

. . . **Henry Daley** writes, "Your recent appeal for class dues really brought tears to my eyes, hence in that moment of weakness I made out the enclosed check. I am in pretty good shape for an old guy who recently turned 80 and who retired from the Sturtevant Division of Westinghouse Electric Corp., 15 years ago this week. I have three married sons, the oldest, Henry Jr., '47, living in Allentown, Pa.; Tom in Rutherford, N.J.; Bob, close by in Willow Grove, Pa. I have six grandchildren, one of whom is married and living in Berkeley, Calif."

Lydia and Jack Dalton spent the winter at Winter Park, Fla. Jack wrote, "Arthur Bond and his sister and **Nelson Stone** and his wife were here at the Alabama with friends for lunch a few days ago. Arthur has a home in nearby Casselberry and the Stones are at the Lakeside Hotel in Mt. Dora for their annual visit. I see Arthur frequently at the University Club in Winter Park where, among other things, he has a major share in keeping the Club library in order, and an excellent library it is too." . . . After a quiet winter in Providence, **John Dalton** is looking forward to golf and bridge. . . . **Dinger Doane**, Reading, Mass., has nine grandchildren, scattered through New Hampshire, North Carolina and Connecticut, with five great-grandchildren in various states. . . . **Ray Delano**, Duxbury, Mass., writes, "As for myself I manage to keep busy between shovelling snow, house work and doing odd jobs in my shop. At our age we all have different situations to pass through. I am looking forward to our next meeting."

George Easter, Buffalo, N.Y., writes, "I am retired but still do patent consulting for the Electro Refractories and Abrasives Division of Ferro Corp. We spent November at Treasure Island, Fla., on the Gulf of Mexico." . . . **Harold C. Edger-ton** writes, "We find the climate of Venice, Fla., ideal for our three or four weekly rounds on the golf course."

"My wife and I plan to do the heart of Europe this summer visiting our daughter, Jean, who has her doctorate and is teaching in Bonn, Germany."

"We have two very active red-headed grandsons, ages four and six, by my son John and his wife Coby."

"This is just a thumb-nail sketch of what we do and our future plans."

We still have many more interesting bits for our column which of necessity we will have to postpone to the next issue.

Boots Malone died April 21 at Uma-

tilla, Fla. He had been sick a long time. He was a loyal and generous supporter of all class and alumni activities. Fran and I used to spend a happy visit with Helen and Boots each summer at their pretty place, an old farm, in Chester, Vt. Boots had a completely equipped shop, where as a hobby he repaired antique furniture.

All the best that you and your family enjoy a healthy, happy summer.—**Azel W. Mack**, Secretary, 100 Memorial Dr., Apt. 2-6A, Cambridge, Mass. 02142

16

It's here, our 58th Reunion, on Tuesday, Wednesday and Thursday, June 4, 5 and 6 at our delightful Chatham Bars Inn far out on the Cape at Chatham. And this will be our 23rd consecutive annual reunion, something we started as an annual get-together way back in 1952 at our 36th. So don't miss this one!

A letter from Montego Bay, Jamaica in February from **Doug Robertson** notes that "Bettina and I are here for our usual short winter vacation. Weather has been fine: Swimming every day with only one or two exceptions." And then Doug gives us information that from him is pretty big news. "I am selling my business, Mount Hope Machinery, to S.W. Industries, Inc., the parent corporation of Stowe-Woodward Co., of Needham, Mass. We have plants in Taunton, Charlotte, N.C., Kimberly, Wis., Lindsay, Ontario, Herstol/Liege, Belgium, Dartford/Kent, England and a world-wide sales distributor for other countries in Lausanne, Switzerland. The business will be continued under the Mount Hope name as a division of S.W. Industries, Inc. Orders in 1973 were the best year we ever had but my job has become work instead of fun so I have decided it was time for me to look for fun again." . . . In March **Dolly and Len Stone** sent us some real vacation cards from way down on Young Island, just off St. Vincent Island of the West Indies, where they seem to have become regular March vacationers. We gave them some foolishness to read on their way down and this time they report "Your recent publication was read at 37,000 feet as instructed. It relieved a rather boring flight to Barbados. Many thanks." They again report "We still find Young Island the nearest thing to Paradise on earth—others might not. We are with two ladies from Jackson Heights—good friends and neighbors—makes it handy for bridge." It must be pretty good there for the postcard picture and the description read, "this delightful anchorage is the centre of the island's active yachting fraternity, just five minutes from the airport, it is the departure point for most of the charter yachts that cruise the enchanting Grenadine Islands. Young Island is a popular cottage-type resort hotel." And of all things—the Stones met and got to know well there your Secretary's personal family doctor, Dr. David Williams and his wife, from Mountain Lakes. Such a small world, this!

Chet Richardson of Youngstown, N.Y., tells us first of all about some of the problems of a fruit grower, especially when specializing in cherry orchards as

he does. He notes that 1973 was one of the poorest production years—only about one-third of a normal-sized crop. Then, "since it costs as much to raise a short crop as it does a full one, (excepting for the harvesting cost), you can imagine what that does to the net. Our net for 1973 was about \$80 for nearly 22,000 pounds of cherries. This was due to poor pollination weather. The bees are strictly unionized—too cold, no work; too hot, no work; too windy, no work; too cloudy, no work. So we did not satisfy them last year. A fellow grower about 20 miles from here, with about 10 days later season, had beautiful weather for the bees and got a full crop. By that time our blossoms were done for. If the weather is not right during the eight to ten days of blossoms, you are out of luck for that year. One reason why most fruit growers have a variety of fruit, and do not depend on just one kind." And Chet writes further that last October he went up to Lynn and Marblehead with his younger daughter to see some of his old boyhood haunts. "On the way through Connecticut we saw a sign 'Canine Rest Area'. On investigating, we found a quarter-acre or so of nicely sanded area provided with several fake fire-plugs and some real bushes. Daughter Jane had to get a picture of this, and in doing so caught an action picture of a dog using one of the fire-plugs. He never noticed it was a fake. Should we complain to the Connecticut Highway Department about cheating trustful dogs?"

Back in February from down in Virginia Beach we have from **Clint Carpenter**, "was pleased to have the picture of the group at the last reunion", and that their weather for the winter was similar to ours—"unusually mild temperatures during much of the winter months." We regret to have his report that "Phyllis suffered a heart attack back early in December and after four weeks in the hospital, she was at home and we were encouraged by her progress." But at the end of January another occurred and she was back in coronary care. But we are glad to hear she was discharged from the hospital on February 14 and was recovering satisfactorily. . . . **Mark Lemmon** of Dallas also fully enjoyed the picture of the last reunion and regrets he won't be able to be with the gang at the Cape this June—says he has had a heart condition for the past year or so and can't get around very much. But for the record he adds, "My heart will always be with the people I met at Tech and I am so sorry that Texas is so far away and I will be unable to be with you."

Elbridge Devine of Pelham, N.Y., lets **Ralph Fletcher** know that every time he reads the Class Notes he is regularly reminded of what Ralph said about "1916 being the best class that ever graduated from Boston Tech." Elbridge notes that he retired from full-time employment a few years ago—development of products for the Graphic Arts industry—and that 1973 was the first year in which he "had not engaged in useful business contacts." As for where he's been—just Pelham, New Rochelle and Ardsley to visit the children and grandchildren. As for what

the grandchildren are doing, "Some are about to enter the unsettled world, but most are, I hope, getting a good start to cope with the many problems. The only philosophy I can add is, Keep your body and mind actively employed—not necessarily financial. I shall soon be out in the yard with a small garden, both vegetable and flowers, plus cutting grass and hedge." . . . **Moe Wolk** in Mattapan is glad to hear regularly of the doings of '16ers, but is sorry he has been unable to take part in our annual doings at the reunions in Chatham. He has had problems over the last year or so, and was either in the hospital or at home recuperating, after some five hours for two operations last year (February and April), but by now he can see "daylight at the end of the tunnel." His sister has been his nurse during this period and to her he is very thankful. We recommend that a note or card especially from Course VI '16ers would be very helpful—**Moses Wolk**, 2 Bismarck St., Mattapan, Mass. . . . **Vic Dunbar** tells of attending the 60th Reunion of his Dartmouth class of 1913, but otherwise last year he spent with son Donald between mid-May and mid-October at their farm in Sunrise Valley, Cape North, Nova Scotia. He says, "The big job this year was adding two rooms to the north side of the house. One has a window showing a marvelous view over the North Aspey River and some ten miles of mountainous highlands extending to Cape Lawrence. The other new room has three all-glass walls with glass doors at each end, one to the sleeping room and the other leading onto a sun deck overlooking Sunrise Valley. This room serves for leisure and sometimes for quiet summer evening meals."

We are very sorry to report the passing on March 1 of **Jack Burbank** of Marston Mills. He had been ill for some time and Helen reports the end came suddenly. He had been with Travelers Insurance Co., 25 years as an officer in charge of the Engineering and Loss Division. In his class history at our 50th, he indicated his professional career was mainly concerned with building construction, engineering management and administration. What gave him the greatest satisfaction was the upgrading of a field engineering staff of over 600, including a special group of eight in the atomic reactor field. He thoroughly enjoyed his retirement on the Cape and in the '60's spent some years on the Planning Board for the Town of Barnstable.

So finally, many will hope to see you at the 58th at Chatham Bars Inn, to enjoy the deep blue sea, the finest of shore dinners, and another one of our special seaside annual delightful gatherings. Until the story of the reunion comes out in the fall issue, keep writing just a little but often to your two willing-to-work Secretaries. As for suggestions, we generally mention what you've been doing, where you've been or are going, who you've seen (or even "whom"), what the children and grandchildren are doing or, as a special treat, a bit of seasoned philosophy.—**Harold F. Dodge**, Secretary, 96 Briarcliff Rd., Mountain Lakes, N.J. 07046; **Leonard Stone**, Assistant Secretary, 34-16 85th St., Jackson Heights, N.Y. 11372



Walter G. Whitman, '17

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Professor **Walter G. (Walt) Whitman** died on April 9 at Scottsdale, Ariz., having had major surgery recently. Elsewhere in this *Review* issue formal notice will be found. Walt's passing will recall to quite a number of us a class dinner and evening in 1956 at the Endicott House. We had gathered to pay our respects to two classmates, **Ray Stevens** on his having received the Gold Medal of the American Institute of Chemists and Walt for his having been selected by the United Nations as Chairman of the Geneva Conference for the peaceful uses of atomic energy. Both Ray and Walt gave interesting details of their experiences. In Walt's case he told of his organizing visit to Moscow. In 1955 the Soviets were regarded with such suspicion that their entry into and cooperation with the conference were doubtful. Walt knew that their presence was essential and insisted on going to Moscow to invite them. In spite of doubts, he and his two associates went. Official visits to Moscow were rare indeed. Walt related that their uncertainty and suspicions were such that all three of his group agreed that at no time were they to be separated even to go to the men's room. However the reception by the Soviets was so cordial and cooperative that in no time the three had forgotten their prearranged safety plans. The result was cooperation at Geneva and a first in diplomatic breakthroughs. It was a most interesting evening ending only when the lights were blinked on us. We are privileged to have had classmate Walt Whitman and will miss him. Two other highlights of that evening were our first opportunity to see Endicott House which **Penn Brooks** had been instrumental in establishing and the message that **Loosh Hill** drew up to Jack Wood who was recuperating from a heart attack. The essence of the message was not to let the doctors' instructions get him down. Quite evidently Jack has done well with Loosh's advice.

Ray Brooks, for the fifth time, got to Mexico City for the Fiesta in March and had the usual good time. It was good to have him and Conchita maintain the

1917 consecutive attendance record of many years.

Via **Brick Dunham** there is a letter from **Bill Sullivan**. He and Brick as well as **George Donovan** were 1913 classmates at Andover Academy. The Sullivans have been doing considerable travelling. Last fall, following an earlier trip to Russia, they flew to England. In due time they took the Orient Express to Istanbul having the unfortunate experience of no dining or food facilities for the entire trip. After touring in Turkey they went on to Athens, visiting some of the islands and also got caught in the student riots. Their return trip was by way of Munich, Ostend and London to arrive home in LaJolla to ask, "Why do we leave our comfortable place?"

Warren Tapley on Cape Cod, made a good recovery from his coronary but of late he has overdone it so, again he is taking it easier. He is delighted with his sixteen-year-old granddaughter passing her "Gold Medal" ice skating tests; his Harvard-Law-graduate grandson and another grandson, a junior at Brown. . . . **Harry Wansker's** name appears as a director of the M.I.T. Club of Southwest Florida on the notice of its "Annual Spring Picnic". . . . The **Bill Hunters** got away in April for a three-week visit to Scotland and England allowing for a week in London visiting old haunts and friends.

Helen and Stan Lane are pleased with the progress she is making after surgery on her arthritic hip in mid-April. . . . **Jack Wood** has consented to be "Ornery" (his term) Chairman of the M.I.T. Sailing Pavilion Committee. Modernization, 30 more dinghies and more storage space are needed. **George Warren Smith**, '26, is Chairman for a \$200,000 campaign.

Glover M. Birk has a new address, 1542 Sunset Dr., New Albany, Ind. 47150.

With regret announcement is made of the death of **Charles A. Abele** at Evanston, Ill., on September 24, 1972.—**Stanley C. Dunning**, Secretary, 6 Jason St., Arlington, Mass. 02174; **Richard O. Loengard**, Assistant Secretary, 21 East 87th St., New York, N.Y. 10018

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I am still grateful to so many of you for responding to my appeal in my year-end message to you. Some of the fruits of those cards are included in these Notes herewith. I need more contact from all of you—how about a newsy letter about what you are doing, where you are travelling, or what else?

In this day of energy crisis here is a most timely and practical program to help solve the problem from our own **Harold Weber**, "A few weeks ago you wrote me intimating that perhaps I had some ideas worth presenting on energy—probably because you remembered I had written a text on thermodynamics, the study of energy and energy transformations.

"I am limiting my statements to liquid fuels and more specifically to those applications where gasoline is now used.

"About 1920 there appeared on the market an automobile fuel called Alco-gas. It was a mixture of gasoline and

ethyl alcohol with a small quantity of a blending agent to allow mixing a considerable quantity of alcohol with gasoline without forming a two-phase mixture. As I remember, it worked better than straight gasoline. It burned cleaner, had a higher anti-knock value than gasoline and could be used interchangeably with gasoline with only minor if any engine readjustments. It shortly disappeared from the market. Soon anti-knock could be accomplished with lead and cracked gasoline was improved so it did not leave gum and other undesirable residues.

"Some years later ethyl alcohol was proposed as an internal combustion engine fuel by some farm groups. Ethyl alcohol is easily produced from a wide variety of vegetable materials by simple fermentation and distillation. Each farmer could produce his fuel from surplus crops, but cheap gasoline and perhaps other factors killed this idea.

"Isn't it time to once again seriously consider ethyl alcohol-gasoline mixtures for liquid fuels? Ethyl alcohol is easy to produce economically even in very small units. The raw materials are readily replenished and not dependent on a finite store. All one needs is sunshine, air and water. This is a good way to utilize solar energy. Alcohol containing fuels burn cleanly and have high anti-knock values. Their use would reduce pollution since alcohol burns to carbon dioxide and water. Moreover such fuels would probably produce lower concentrations of nitrogen oxides than do straight gasolines. By the use of alcohol mixtures, or possibly straight alcohol, we could become self sufficient in liquid fuel, our balance of payments would be improved and there would be no such thing as a farm surplus. Of course the restrictions on ethyl alcohol would have to be changed but this would seem a small effort for the advantages offered. Incidentally the residues from fermentation are a good cattle food and of course the manure could be used to fertilize crops.

"With gasoline now selling at \$.50 a gallon and going higher, a lot of things look attractive economically which did not look so good in 1920, when you commonly bought eight gallons of gasoline for one dollar."

Thanks to Len Levine here is an interesting biography from **Dave McFarland**, "I note you still have the energy to keep active after you were obliged to retire. That is good and keep busy so long as you are able.

"On June 1, 1962 I was retired by the Atlas Power Co., after being with them since 1920. My first work was at the Experimental Lab near Tamaqua, Pa., working on Electric Blasting Caps and Electric Blasting Accessories such as blasting machines and testing instruments. In 1927 I was moved to the General Office in Wilmington, Del., to the Lechmeal Division of the Sales Department. In 1934 I became head of that Division. My work was to assist the salesmen with their problems in the selection and application of explosives and to present our field problems to the Experimental Lab as to what products were required to meet competition and do the job properly.

"I spent much time in the southwest with the seismograph crews prospecting for oil. In the course of my work I was awarded several patents that were of course assigned to the company. The most notable of these was a system of millisecond delay blasting that has become widely used around the world. It has minimized the shock from blasts and created better breakage of the material being blasted.

"The Explosive Companies had an organization known as the Institute of Makers of Explosives. I represented our company from 1934 to 1962 on the Technical Committee of the Institute, being Chairman of this committee for several years. We had much to do with assisting the government and various states in the formulation of the codes governing the storing and handling of explosives.

"My wife of almost 49 years and I have just returned from the annual Antiques Forum at Williamsburg, Va. We generally see Sam Chamberlain there but missed him this year. Among some of our prized possessions is my etching of Old Rogers by Sam.

"We have two fine daughters. One graduated from Middlebury, is married to a Harvard Ph.D., and lives in New Canaan, Ct. The other graduated from Johns Hopkins, as a nurse, is married to a Doctor at Johns Hopkins and lives in Baltimore. We have seven grandchildren.

"For exercise I take care of a good sized yard and an acre of garden. We raise and freeze nearly all of the vegetables we use. This keeps me in good physical condition.

"I guess I am just an Indian and not one of the chiefs but someone has to do the work.

"I am saddened by the deaths of so many old friends."

John Abrams, one of my most frequent correspondents turned eighty on February 1974. More power to you John and years of good health and happiness to you. He is a concerned citizen as his letter indicates. We need more like you, John. He writes, "*Musings of an Octogenarian*. Yesterday I turned eighty. For 40 years I've been in better-government pursuits, starting with graft-ridden Los Angeles City and County in the early 1930's. I headed the crime-fighting "Committee of Fifty" of The Minuteers Association of which John Anson Ford was an advocate. I've been at it ever since."

We received with sorrow the news of the death of **Arthur A. Obert** on June 11, 1973. . . . Our sympathy goes to **Pete Strong** whose wife passed away on April 7, 1974.

George Smith, my counterpart for the Class of 1926 and one of the best in this business wrote me concerning the number of yachtsmen, or sailors to be found in our Class. He would like to have your names in an effort to improve the M.I.T. Sailing Pavilion. Any enthusiasts write **George** at P.O. Box 506, Pigeon Cove, Mass. 01960.

New address changes: **Stuart H. Caldwell**, 27 Smith Rd., Rockport, Mass. 01966; **A. De Zubiria Stevenson**, Carrera 4A No. 684, Bocagrande, Cartagena, Columbia, So. America; **Edgar N. Goldstine**, 1880 Jackson #304, San Fran-

cisco, Calif. 94109; Wendell H. Kayser, 3700 E. Bellevue, Tucson, Az. 85716.—**Max Seltzer**, Secretary, 60 Longwood, Ave., Brookline, Mass.; **Leonard I. Levine**, Assistant Secretary, 519 Washington St., Brookline, Mass.

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Address changes have been received for **William H. Banks**, 170 South Rd., Rye Beach, N.H. 03871; **Clarence W. Bates**, 16 Euclid Ave., Winchester, Mass. 01890 and **Harold C. Moberg**, 12 Idlewood Dr., South Yarmouth, Mass. 02664.

Charles Drew called from Miami where he vacationed in March. All's well with Chuck. He mentioned that Fred Barnes' wife had remarried.

Your Secretary will be in Massachusetts this summer, at Captain Cobb House, Hyannisport, from June 25 to July 10; and at Rocky Shores, Rockport, Mass., from August 1 to September 15.

But we all hope to enjoy our 55th at Chatham Bars Inn May 31, June 1 and 2 and at the Institute on June 3.—**E. R. Smoley**, Secretary, 50 East Rd., Delray Beach, Fla. 33444

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By this time, that ubiquitous, world traveller, **Harry Kahn**, is back home in Oxbridge, "just in time to start mowing the grass," says Harry. Before he left for the Philippines he did a bit of snow blowing but found Manila at 90 degrees, amply warm. Previous to his trip to Manila, Harry spent a few days in Tokyo arranging for a consultant activity with a Japanese company to start a tile factory in the Philippines. Before that, this lively couple, Hannah and Harry, were on an assignment in Greece only to get caught up in the revolution there. Glad you're home, safe and sound, Harry and Hannah. . . . Another great traveller, **Francis Sears**, advises that he and Mildred took off on the **Lindblad Explorer** for an extended cruise down to Tierra del Fuego and up the west coast of South America. The Sears' home is in Norwich, Vt. . . . **Freeman Dyke** writes to say that he and Alma now spend the summers away from their home in Jupiter, Fla., on a fine trout fishing lake in Robbinsville, N.C., where they enjoy the fishing and rural living.

Congratulations are due Ella and **Al Wason** on the occasion of their golden wedding anniversary this June. . . . Betty and **Norrie Abbott** are on another of their unusual trips, this one around the Danish islands then to Belgium, Luxembourg, the Moselle to Coblenz, finally flying to Geneva and then on one of their beloved railroads, ending up in Zurich. More power to them!

Word has been received of the death of **Garth C. Boyer** of 1210 Grey Court Ave., Richmond, Va.

Our 55th Reunion is now less than a year away. Time for you to be making your plans to attend. The M.I.T. homecoming weekend has been scheduled for Friday, June 6, to Saturday, June 7, not the Sunday-Monday combination as in the past. Reservations have been made for

us at McCormick Hall on campus and those who attended the 50th will know that it is unsurpassed for convenience, food and accommodations. Plans for your delectation and joyous activity are being made and will be divulged shortly. Spouses will be warmly welcomed, of course. A note indicating your interest will be appreciated by—**Harold Bugbee**, Secretary, 21 Everell Rd., Winchester, Mass. 01890

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Many of you will have received the letter of March 21, 1974 sent out by our Class Photo Historian, **Robert F. Miller**, announcing the completion after many months of the Buckner-Miller photographic project of the Class of 1921. Most of the individual pictures were taken of classmates or couples at our 50th Reunion by **Laurence O. Buckner** and mounted by him to make an 11 by 14 inch montage containing pictures of 112 classmates. Bob Miller's letter went out to 150 classmates or widows but presumably others will be interested in getting a copy. This can be obtained by sending \$5.00 (which includes the 55 cent cost of the protective mailer and postage) to **Robert F. Miller**, 3386 Chiswick Court, Silver Spring, Md. 20906. An identification diagram will be mailed with the picture. Quoting from Bob's letter: "The project from the start has been a challenge and never would have been possible but for the excellent technical work by Buckner. It is probably unnecessary to add that the untold hours of work have been a labor of love for the Class by Buckner and myself." To date (April 15) Bob has received orders for 80 pictures. The thanks of the Class go to Bob and Buck.

Two reports of the 26th Fiesta in Mexico City have been received, one from **Jim Parsons** of Sarasota, Fla., and the other from Assistant Secretary **Sam Lunden** of Los Angeles, Calif. Jim wrote that our distinguished classmate **Manual Sandoval Vallarta** was among those present. Both the Parsons and the Lundens found Dr. Disher's illustrated talk on the Apollo and Skylab missions of great interest and "not so technical as to overwhelm his audience." The tour through the new Metro subway system and control center also proved "marvelous" and with "no graffiti" in evidence. The visit to the nuclear research center at Salazar was impressive and "pretty much M.I.T. designed and operated." And of course, the climax of the Fiesta—the Noche Mexicana in the lush gardens of Louisa and Nish Cornish—was the usual exciting and colorful finale. Leila and **Sam Lunden** were celebrating a 49th wedding anniversary on their trip to Mexico. After the Fiesta, Helga and **Jim Parsons** took a three-day trip to Oaxaca which included inspection of the ruins of Monte Alban and Mitla—an anthropologist's delight.

Harry M. Witherow wrote that his wife Helen died last September. One of his twin daughters and her family moved in with him so Harry is planning to stay in Schenectady, N.Y. The Witherows both attended our 50th Reunion and cele-

brated their 50th wedding anniversary in 1972. The sympathy of the Class is extended to Harry and his daughters. . . . A nice long letter from **Ed Delany** tells of his and Kay's getting settled in Naples, Fla., as their year-round abode. . . . Helen and **Mich Bawden** are next-door neighbors but are still "snowbirds" travelling back to Duxbury every summer. On March 5 Ed Delany, Mich Bawden and Ed Ryer, '20, hosted a cocktail party at the Naples Country Club which included amongst others **Herb Gwynn**, **Phil Payson** and **Dick Windisch** of the Class of 1921. The following week Uncas Whitaker, '23, entertained M.I.T. Chairman Howard Johnson at a party in Port Royal, Fla. Howard wore his 1921 red jacket and with several other red jackets in the room, he referred in his talk to his affiliation with the Class of 1921. Invited guests from '21 included Helen and Mich Bowden, Edna and **Phil Coffin**, Margaret and Dick Windisch and Kay and Ed Delany. . . . Footnote: a card from **Rufe Shaw** tells of his having lunch with Edna and Phil Coffin the day after the party for Howard Johnson.

Early in April, Ruth and **Irving Jakobson** were hosts at a luncheon at the Manhasset Bay Yacht Club for Irvina and **Ray Cooper**, Jane and **Dayton Brown** and Betty and **Sumner Hayward**. Jake toasted his guests in verse especially composed for the luncheon. Ray Cooper was recently hospitalized for surgery but is making a good recovery so that he and Irvina were soon flying to Switzerland with their daughter and son-in-law for a brief vacation. The Cooper's son-in-law is a top specialist in colostomy and is attending a medical convention in Switzerland. The Dayton Browns were recently returned from a Caribbean cruise which included a stop in Yucatan. They visited several of the Mayan ruins, some of which have been hacked out of the jungle in recent years. As reported two months ago, the Jakobsons also took a Caribbean cruise in February, won in a Red Cross raffle. This was on the *Queen Elizabeth, II* which Jake inspected fore and aft. In the light of the recent complete boiler failure on that vessel, Jake was quizzed but could only express mystifications as to what happened. "With back-up equipment and facilities all over the ship, the complete breakdown is incomprehensible."

Assistant Secretary **Josh Crosby** reported that his neighbor **Whittier Spaulding** was recovering nicely from surgery in early March so that he and Josh were planning to attend a ball game in Sarasota on April 1. Josh also had an invitation to attend Marion and **Phil Payson's** 50th wedding anniversary celebration on April 9 in Fort Myers. If gasoline were available, Josh and Claudia planned to go.

Elliott Roberts of Westmoreland Hills, Md., wrote that he and his wife Becky occasionally see Kitty and **Dick Smith** of Chevy Chase. The Roberts are music lovers and go regularly to the symphony and the ballet, but their special love is opera. Said Elliott, "We have some fairly good opera here but we also go afield. A couple of years ago we went on an opera tour to five European cities to hear

nine operas in 15 days. Life on the whole is quiet these days—I'm still thinking of writing another book or two [tell us more] but at 75 thinking is easier than doing."

With sorrow we report the death of our Class Vice President and 55th Reunion Co-Chairman, **Edwin T. Steffian** on April 26, 1974. For many years Ted was Assistant Secretary of our Class and at our 50th Reunion accepted a joint responsibility with Ed Dubé for planning the next reunion. Ted was born in Mexico City, attended Phillips Andover Academy, took special studies at Columbia University and studied architecture at M.I.T. He was still active as President of Steffian, Steffian and Bradley, Architects. Many of the present Boston skyscrapers were designed by his firm. Ted was the recipient of several architectural awards, a Fellow of the American Institute of Architects, Chairman of the Design Task Force for the Harvard Square rehabilitation, and board member of many other organizations. The sympathy of the Class goes out to his wife, Lovina and their two sons.

By the time you read this Alumni Day will have come and gone. We hope you will have an enjoyable summer—**Sumner Hayward**, Secretary, 224 Richards Rd., Ridgewood, N.J. 07450; **Josiah D. Crosby**, Assistant Secretary for Florida, 3310 Sheffield Cir., Sarasota, Fla. 33580; **Samuel E. Lunden**, Assistant Secretary for California, Lunden and Johnson, 453 South Spring St., Los Angeles, Calif. 90013

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In our last notes we were thrilled by the letter from President **Parke Appel** and included most of his comments with details of his trip to come. Your Secretary still hopes to see Parke as he travels through Madrid on the way to Mallorca in April. The thrill for all of us will be to visit with Madeline and Parke at the June Reunion as they stop on their way home to Venice, Fla. . . . A note from **Ken F. Morgan** included beautiful colored pictures of his home on Balboa Island near San Diego. The pin hole on the over-all view indicating their home on Grand Canal is a clever feature. Ken and Dorothy look younger than ever and promise to be with us whenever possible. His exciting activities during the evolution of sound tracks on film with Howard Hughes, Walt Disney, John Barrymore and others follow the path of the perfecting, by the Bell Laboratories, of sound and color on film as we know them today. During the award of the Oscars in April we were looking for Ken Morgan to be called to the stage—or was he that streaker who went by David Niven. . . . **Donald F. Carpenter** of Mendenhall, Pa., has written that he will host the annual dinner of the Class of '22 Professors during the commencement weekend at M.I.T. Louise and Don spent several weeks in North Africa during April.

George W. Smith, 1926 Secretary, has asked for names of yachting enthusiasts in our Class. He is hoping to work with

a group to improve the M.I.T. Sailing Pavilion. His address is Post Office Box 506, Pigeon Cove, Mass. 01960.

Roger Hayward has written from his new address in Merced, Calif., that he and Elizabeth are learning to relax since moving from Pasadena. He says that an assortment of accumulative impedimenta from 32 years of savings totalled 11 tons. He has no firm commitment looming except acting his age! After 24 years he found it necessary to cease illustrating the Amateur Scientist column of the *Scientific American*. . . . We must have all received that old nostalgic feeling in receiving the brochure of Historical Collections at M.I.T. The picture of the new Technology Institute with the graveled court and the steps near the front illustrate the immensity of the 1916 project. Vannevar Bush is shown with the mechanized motor driven computer, the forerunner of today's technology. . . . **Harvey Williams** came out of retirement in December, 1973 to accept the invitation of the Trustees of the United States Council of the International Chamber of Commerce to become President of the Council. Williams had been a member of the Council's Executive Committee and a Senior Trustee. During the Kennedy round of tariff and trade negotiations he had served as Chairman of the I.C.C. Commission on the expansion of international trade. Harvey will remember working with Van Bush and with your Secretary in the Electrical Laboratories. Last December he was also elected Secretary and Treasurer of the U.S. Business and Advisory Council to the O.E.C.D. in Paris. . . . **Lloyd A. Elmer** who has been with the McKiernan-Terry Marine Division of Litton Industries in N.J., tells us that he has recently rebound his *Applied Mechanics* by Fuller and Johnston, Volume II, *Strength of Materials*. Its constant use by Lloyd indicates that this science does not change. . . . **Everett M. Strong** and Ella of Ithaca have been visiting their children and families in Bangor, Philadelphia (Swarthmore) and New Orleans. They also spent a few days along the New England Casco Bay. His time is filled with technological society meetings, some consultant work, U.S. Power Squadron and the Ithaca Yacht Club. Ella and Everett have been busy this winter skiing on their own hillside overlooking Cayuga Lake to keep fit for the 55th Reunion. We will all look forward to seeing them. . . . We share in the honors bestowed upon **George C. C. Maling, Jr.**, of New York City, who has been elevated to the grade of Fellow in I.E.E.E. for his contribution to noise control engineering and to standardized methods of sound power measurements.

The sympathy of our Class goes to the family of **Albert Kruse** of Wilmington, Del.

We are happy to report that all the tornadoes, wind storms and weather problems have again missed the Buffalo area so that we are able to invite any and all to a life, in western New York, of golf and happiness—in that order. May your summer be most pleasant.—**Whitworth Ferguson**, Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; **Oscar Horovitz**, Assistant Secretary, 3001 South Course Dr., Pompano Beach, Fla. 33060

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We have received a clipping (undated) from *The Tech* concerning another generous gift from the **Cecil Greens** to the Institute. The latest gifts, two in number from Cecil H. Green and Ida M. Green "will be used to help support the new Division for Study and Research in Education and for the establishment of fellowships aimed expressly at female graduate students." President Wiesner, in separate statements relating to the two gifts, stated that these were "an exceedingly generous expression of confidence in the new venture (D.S.R.E.)." We can again applaud the Greens for their continued generosity and interest in the continued improvement of educational opportunities at M.I.T. and again express our pride in having Cecil as a classmate.

Have just received a belated notice, this time indirectly through the Alumni Association office mill, that **Herb Hayden** suffered a second stroke last Thanksgiving. This has definitely affected his ability to walk and stand but in talking with Herb today he seemed in great spirits and told us that he continues to improve and continues to keep trying. Best of luck to you, Herb! . . . A few weeks ago we telephoned **Dave Davenport** to learn progress, if any, on getting out the "Great History of the Great Class of 1923, M.I.T."

He did tell me that because of other delays he decided to include a story concerning the 50th Reunion. This, of course, has added to the time element. He can be reached through area code 804-428-6946. . . . **Albert J. Pyle** and wife Miriam on a post card from Mexico City write, "How I wish New York City could have such handsome, clean subways! No litter, cars with rubber wheels and almost no noise. This station is Bellas Artes which we reached last night en route to Folklorio." The picture card that Al sent shows gleamingly clean, polished floors, walls and ceiling, also gleaming, polished cars with no graffiti! So like the subways of New York! We get the message, Al. . . . From **Hugh D. Chase** we learn via the Alumni Fund routing—"My fifth year of retirement. Am just enjoying myself with local activities. Usually go back to the 'Old Homestead' in Maine during part of the summer." . . . From **David M. Houston**, by the same route we learn—"semi-employed, largely with non-paying political and charitable activities."

From the Alumni Office we learn of the death of **Harry S. Rubens** of St. Petersburg, Fla., on February 28, 1974. We will try and get further details.

To those of you who may have missed earlier issues, **Lyman L. Tremaine** and **Thomas E. Rounds** now reside in Heritage Village, Southbury, Ct. 06488. The former's address is 517 Heritage Village and the latter's as shown below. Lem moved in last September and Tom last March. Lem says that he will stay and we think so too.

Notice

Pete Pennypacker, our Assistant Secretary, reports that on April 20 he received his copy of "A Great History of the Great

Class of 1923." Pete says that the book arrived about 2 p.m. quite unexpectedly and he sat right down to read it, putting aside all other matters. He stopped to have supper and continued his reading which he has not yet finished. Here is his reaction. "Phyllis and **Dave Davenport** have performed a superb job supervising the preparation of this unique record of our Class. There are 350 pages. The book is fascinating. It has been made possible only by wide-spread efforts of many classmates who have contributed anecdotes, personal records and pictures. The book includes records of all our classmates about whom any information could be found. All Class Reunions are recorded in group pictures and entertaining informal snapshots. Outstanding accomplishments of the Class as a whole are given. A wealth of talent is clearly revealed in many branches of technology, science and engineering. While the book is primarily factual it contains much good humor and is written in a most interesting style. The book emphasizes the spirit of unity which has always been strong in our Class."

Doris and Pete called Dave and Phyllis to congratulate them and were told that of a total of about 500 books almost 150 have been mailed thus far. Pete assures his classmates that they will be delighted with their books when they arrive and states that this book deserves to be in the library of every member of the Class.—**Thomas E. Rounds**, Secretary-Treasurer, 990 A Heritage Village, Southbury, Ct. 06488

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The curtain has rung down on our Golden Fiftieth and all are homeward bound with memories of some that we had not seen for half a century; more knowledge of far away places from "those who were there"; thoughts of the personal and business experiences of others; and mental food for the future. The complete story of "'24 in '74" should be forthcoming from our venerable Chairman, **Paul Cardinal**, but I hope also for an early digest to incorporate in future Notes.

Commencement in 1975 will be switched to a Monday, as it was generally before 1946. The Annual Alumni Reunion will be rescheduled to the week-end following Commencement. This procedure will relieve pressure on submission of final grades and determination of qualifications of degree candidates. It should also increase Alumni Day participation since Sunday will be "back to the grind" day for business on Monday.

Belatedly, we have received word of the death of Colonel **Morris K. Barroll, Jr.**, on August 5, 1969. Although registered in our Class, little is known of his career. At one time, he was addressed at the Springfield Armory, Springfield, Mass.

I have a letter from George Warren Smith, Secretary of '26, Pigeon Cove, Mass., inquiring for yachting enthusiasts in our Class. That sport never was in my repertoire, but I sent him a possible list to help with plans to improve the

M.I.T. Sailing Pavilion

A note from **Earle Wild**, Park Ridge, Ill., indicates that he is retired and in good health but plans not to attend our 50th. We would guess that "Oscar" retired from the executive echelon of Commonwealth Edison, Chicago, and has been active in the American Institute of Electrical Engineers.

Quoting a note from **Dick Jackson**, Tampa, Fla., "Learned to fly in 1958 but have given it up. After all, with my 72nd birthday coming up soon, with a total of 600 hours, decided I'd had enough. The rest is bad news. Had surgery not long ago and later suffered a Cafe Coronary. If you do not know the meaning of this, ask your doctor. Otherwise, healthy and happy."

Paul Cardinal has forwarded a letter from **Nish Cornish**, Mexico City, enclosing a photo of a "diploma" awarded him and **Rut Torres** by the Mexico City Alumni Club of M.I.T. for "understanding leadership and enthusiastic devotion for 50 years of sustained service and support," promoting alumni good will around the world. Nish and Luisa plan to team up with the **Webster Brockelmans** of Framingham, Mass., for our reunion activities.

Frank Shaw, 50th Co-Chairman, and your scribe are still puppets of the Chairman, **Paul Cardinal**, Naples, Fla., and continue to react to his string-pulling from afar. You all should have received his No. 3 letter and a Directory appropriate to our Golden Fiftieth Reunion. We tried to think of everything but if we missed, wait for our 75th!—**Russell W. Ambach**, Secretary, 216 St. Paul St., Brookline, Mass. 02146

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Gilbert L. Delugach writes from Memphis, Tenn., where he lives in what he terms semi-retirement. He still maintains a real estate office with a nephew. Gil and his wife, Gertrude, do quite a bit of traveling and they plan to visit the Commencement at Yale where his granddaughter attends. He still is interested in golf and bridge. Class activities include serving on the Educational Council and as State Chairman for the 50th Reunion Gift. He says that most classmates live in East Tennessee and he regrets that he does not have an opportunity to see them personally. He plans to be with us for the 50th. "Our weather here is intermittent, some days are good and some cool. Crocuses have all gone and the forsythia is starting to bloom. On good days my project is painting the fence, not too much of it but there are four sides to each picket."

I am sorry to have to report the passing of **Winthrop R. Francis** of Glenn Ridge, N.J., on August 20, 1973; of **James R. Geddes** of Lubbock, Texas in October, 1973, and of **Galen A. Wallace** of Tallahoma, Tenn., on February 2, 1974. Galen was stricken by a heart attack at his home and services were held in the First Presbyterian Church in Tallahoma. He was an employee of the Army Corps of Engineers for 40 years from which he retired in 1965. He received a bachelor's degree from Ohio Wesleyan University

in addition to his degree in civil engineering from M.I.T. He joined the Corps in 1925 and went to the Arnold Air Force Center in 1949. He was named Chief of the Corps' Tallahoma Division and organized the work at the Center. He was responsible for the building of the air center, the Elk River Dam and Reservoir and all phases of the installation. In 1960 he was named Special Assistant to the Mobile District Engineer and four years later he received a special award from the Corps for outstanding service on Arnold Center Construction. He was also engineer of record for the Wappapillo and Clairwater Dams in Missouri, the Blue Mountain and Nimrod Dams in Arkansas and the Great Salt Plains Fort Supply and Canton Dams in Oklahoma. On his retirement in 1965 he formed his own consulting engineering company. He was a member of the American Society of Military Engineers and a Fellow of the American Society of Civil Engineers. He is survived by his widow, a son and three grandchildren.—**E. Willard (Will) Gardiner**, Secretary, 53 Foster St., Cambridge, Mass. 02138

A Stylus Certificate?

Shedd Vandenberg, '25, wants to replace with a copy his certificate of membership in Stylus which has been lost. If you were a member of Stylus, the honorary undergraduate literary society, and can loan him your certificate for the purpose, please write him at Box 756, Rancho Santa Fe, New Mex., 92067.

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Today is what we call a "Bermuda Day" here at Pigeon Cove. The sky is full of clouds but the sun is brilliant and the surf moans out the same tune as in Bermuda. We usually remark on such days, "Why go to Bermuda when we have the same thing here?" Well not quite—it's Patriot's Day, the day of the Marathon, and Bermuda would be a little warmer and the sailboats would all be out, ours are just beginning to have their covers removed for a first peek. We did manage a little preview a couple of week-ends ago by visiting the Ocean Reef Club about 50 miles south of Miami for their wind up and we got into a Bullseye for their last race—it was a real treat. Then when we returned and attended a meeting at the M.I.T. Sailing Pavilion, there were five or six hardy souls in dinghies out on the windy river and two of them flipped. Even though quickly and skillfully righted, we shivered for them. While on our Florida weekend we tried to contact classmate **Pete Doelger** at Palm Beach but he and Margaret were on a cruise around the world. We caught up with Billie and **Willard Vaughan** at Seminole on the other coast for a half-hour visit and could not quite figure out whether they have accepted Florida in the two years they have been there.

My brother-in-law and classmate **Edwin Southworth** at Clearwater has undoubtedly accepted Florida but he has been there for 16 years. We managed another

short visit to retired Dean **Tom Pitre** at Dunedin and there is no question about Tom and Hester's acceptance of Florida and Florida's acceptance of them. They both look wonderful and their double apartment at Mease Manor closely resembles the setup they had at 100 Memorial Drive.

A note for 50th Reunion Chairman **Don Cunningham** tells us, "Mary and I have just returned from Mexico and the hospitality of the M.I.T. Club of Mexico City. Nancy and **Louis Darmstad** filled out the '26 contingent. All the good reports I've heard from previous classmates about these affairs are more than true. It was a wonderful experience. You ought to try it." . . . This was an additional wedding trip for Don and Mary since they have only been married three or four months. . . . Here is a note (on the back of an envelope and very welcome) from **Ed Manning**, "Retired from Scovill Manufacturing Co., in 1967. Have travelled to every state in the U.S.A. except Alaska, also to east and western Canada." . . . And another similar note, "Retired nearly four years, but keep out of mischief as Secretary of New Hampshire State Board of Registration for Professional Engineers. **Stanley P. Sawyer**."

These Alumni Fund envelopes are life savers for a Class Secretary who is itching to get out and absorb some of his nice "Bermuda Day." . . . **Jim Killian** is back in the news with a new assignment as Chairman of a committee formed by the Council of the National Academy of Sciences to study the relationships between science and technology and government. . . . Finally a letter from **Harry Howard** points out that we put his name into two clippings in the February Notes. One had him in the transportation business and located in Washington, D.C.—I think that belonged to 'Hank' Hoar. Harry is retired from the printing business at Orleans on Cape Cod and consults still in the graphic arts and book industries. Harry is President of the Orleans Men's Garden Club and reports **Elton Staples** to be an active member. Before signing off we want to ask any sailing members of the Class to step forth and be counted. We probably know most of the sailing enthusiasts but do not want to miss any. We recently asked our fellow Class Secretaries for such a list and they came up with 70 names! I believe I can now list about a dozen in our Class. Being one of them I'm heading for our Yacht Club as soon as I say "Cheerio", to see a brand new Etchells 22 that was delivered to a friend yesterday—so cheerio untill July.—**George Warren Smith**, Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

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On April 21, **Erwin Bramhall** was married to Marian Morey in Sun City, Ariz., where he has been living since 1970. The new address is 10510 Mission Lane, Sun City, Ariz. 85351, and he offers to welcome with a spot of cheer any classmate who is passing through that "oasis of the Southwest." . . . **Brad Gerrish** writes further about the condominium which is being built next door to him at Melvin Village,

Lake Winnepesaukee: "I am not in the real estate business," he says, "but if you should know of anyone who is interested in this four townhouse condominium, I will be glad to see that full information is sent to him by the owner, who lives here on the property. Each unit has full basement and two floors, with two or three bedrooms. Beach privileges are deeded, and dock facilities are available. I would expect the prices to be in the low forties." He adds, "We had a very easy winter, with less snow than in southern New England, and only one extremely cold spell." Sounds as if Brad is anxious to have a classmate as a neighbor. . . . **Ray Hibbert** says he has no newsworthy events to report—which, these days, is good news. "Zell and I have been staying close to New Canaan," he says, "and I continue my sales agency business as heretofore." . . . **Al Billings** has chosen a retirement community, Leisuretowne, which is a disconnected suburb of Vincentown, N.J., about 20 miles east of Camden. "Our youngest daughter and family (two children) live in Cherry Hill—the principal inducement for moving here from Cumberland, Md., a year ago. Now we are beginning to feel like old residents." . . . **Larry Coffin** is still helping out at the Maine Maritime Academy. "Had a fine cruise to the Caribbean on the training ship *State of Maine*, he reports. He adds that they are spending their winters at Beaufort Bay, Fla., and keeping well.

Russ Westerhoff sends me a double dose of sad news about two of our classmates. **Gordon Jacoby** died early in April at his winter residence in Seminole, Fla., and **Willard Felch**, whose hospitalization in October was reported in the December Class Notes, died last year.

Gordon formerly lived in Wyckoff, N.J. He was a member of the Passaic County Society of Professional Engineers for many years. He had moved a few years ago to Bricktown, in the southern part of New Jersey, and maintained a home there as well as in Seminole. He was a retired structural engineer and had worked with American Bridge Co., Maine Central R.R., N.Y. Central R.R., American Gas and Electric Co., and D. B. Steinman Engineer Co., and later formed his own firm, Jacoby and McGrayme Co. He is survived by his wife, the former Margaret Mathieson, two sons and a daughter, and six grandchildren.

Bill Felch retired in 1970 after a career with the telephone company, his last title being Supervising Engineer, Long Lines Department. After retirement he kept active with ham radio and Civil Defense.

Russ Westerhoff had an operation on March 1, and when he wrote on March 31 he was recovering very rapidly. He says that there was no urgency about the operation but the doctor thought it would be a good idea to have it over with to avoid a problem of finding a doctor in some outlying corner of the world. Russ and Catherine are inveterate travelers.

There is one other death to report this month—**George Taminosian**, who died on January 14. George had retired as Supervisor of Research and Statistics in the Division of Employment Security, Com-

monwealth of Massachusetts, and also from the Air Force Reserve. His wife had died in 1971. He is survived by his daughter and eight grandchildren.

Speaking of grandchildren, these Notes almost didn't get written. My daughter has been visiting us with her two children (4½ and 2½), and since they don't get up here from Atlanta very often, I begrudge any time I could spend with the little ones and don't. With the front pages filled day after day with indictments and convictions for perjury, it's a real joy to be with a couple of little boys who haven't yet lived long enough to learn to dissemble.—**Joseph H. Melhado**, Secretary, 24 Rodney Rd., Scarsdale, N.Y.

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A short note from **Des Shipley** says "This seemed like the year to stay on this continent so, as your class traveler, I did the Maritime Provinces. They are delightful; early fall is best. In other seasons you can have mosquitoes, midges, black flies, etc. Unfortunately my activities were somewhat curtailed by the steamship-railroad strike. In Nova Scotia I enjoyed Cape Breton Island and especially Yarmouth." . . . **Ben Hough** reports briefly that he is still in active practice and that he attended a conference in Moscow, U.S.S.R. with wife, Marjorie, and their daughter in August of 1973. . . . **Franklin McDermott** writes "Marjorie and I are still reliving that marvelous 45th Reunion. We are truly grateful to all those great vice presidents who put it together, with extra kudos to President Jim. Aside from a round trip motor tour to California (from Darien, Ct.) and way stations, we have done little for excitement since the reunion." . . . **Jack Rouleau** reports, "Alice and I sold our house at Cape May, N.J., and are now living in Montgomery Village, Gaithersburg, Md." Jack noted that the reunion list of class members contained some 27 doctor titles, most of which he assumed were non-medical. He was reminded that his own Ph.D. was acquired at Boston University School of Medicine working on sex hormones with Dr. Allen Winter Rowe back in 1937. . . . Kay and **Ben Draper** took a vacation trip to Bermuda last year and plan to do so again this year. Ben is still busy in the textile manufacturing business and expects to work as long as he is serviceable. . . . During his travels in late March, **Jim Donovan** found himself on the Columbia River near **Gil Ackerman's** home town. Jim telephoned Gil who then went to the airport where they had a good meeting. Gil is on the local "Port Authority" group which, by Jim's account, is doing an excellent job on local transportation facilities. Gil is already looking forward to the 50th in 1978.

With deep regret we must report the deaths of two classmates. **Dave Mathoff** died on April 11, 1974 at his home in Boston. We talked with his wife, Dora, and expressed the sympathy of the Class. Dora mentioned that she and Dave had observed their 50th wedding anniversary just last November.

Elwood R. Anderson died in December of last year. The information has only

now come to our attention and we have no further details at this time. Our heartfelt sympathy goes to his family.—**Walter J. Smith**, Secretary, 209 Waverly St., Arlington, Mass. 02174

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Richard J. Coveney, whose untimely death was reported in the March issue of the *Review*, turned out to be an accidental tragic one. He died in his fourteenth floor apartment which was completely gutted by fire. He was rushed to the Cambridge hospital and was pronounced dead on arrival. He had recently retired, as Vice President of Arthur D. Little Co., after 23 years of service. He leaves a son, Richard M., of Scituate, and three grandchildren. . . . Word comes that **Charles N. Henshaw** of Chazy, N.Y., passed away on March 21, 1974. No details available at this time.

Stephen N. Dilworth, who recently retired from Graphite Metallizing Corp., a firm owned and operated by **Warren W. Walker**, has moved to an adult retirement community where he is getting started in a new and easy life style. . . . **James C. Reddig** writes, "This has been a relatively quiet year, though I managed to get to the home base of the delightful Confederate Air Force at Harlingen, Texas, and a visit to the splendid new home of the Air Force Museum at Dayton. I also visited the Curtis Museum at Hammonspont, N.Y. I plan to attend our 45th Reunion but unfortunately my wife will not be with me, as she will be attending her own college 45th Reunion that falls the same weekend." . . . A note from **Raymond Underwood** reads, "Your birthday card arrived while I was on a group tour in Africa. In fact, I celebrated my birthday at Victoria Falls. I retired two years ago, I decided to open an office for the private practice of a patent attorney, which I have thoroughly enjoyed. It keeps me busy when we are not away on trips."

Received a post card from Caracas, Venezuela sent by **Hunter Rouse** which reads, "Dear Karnig, this may spare you sending me one of the many birthday cards that you so faithfully send out, as I shall still be in Venezuela next month (March). For February this is perfect swimming weather here. The trick is to find a laboratory that can use your services at the right time of year. DoI joins me in sending good wishes to you all."

Though it has been two years since **Hunter** retired as Dean of the Engineering School, University of Iowa, he seems to have a full load of academic activities, lecturing, writing articles for technical journals and doing consulting work in his field (hydraulics). As a guest editorial, he had an article "Dimensional Continuity in Engineering Education" which appeared in the November, 1973 issue of *Engineering Education*. "Technical knowledge has its place not only in the design office or the factory, but also in the board room, the foundations and in the legislature" was the theme.

Richard Piez classes himself three quarters retired, having sold his business, but agreed to stay on with the new owners for some months. "I am planning

to attend our 45th Reunion", he continues, "as it would give me an opportunity to travel in the northeastern part of the country which I enjoy. Perhaps the energy situation will be the deciding factor, whether I will be able to carry out my plans. . . . **Isidor Winer** is enjoying a quiet life of retirement and working part-time with several service organizations just to keep himself busy. . . . **Norman M. Wickstrand** is still doing part-time teaching at the University of Connecticut. "I am teaching algebra and trigonometry at present", he continues, "and will teach statistics next semester. I also do some part-time consulting work for the Torrington Co., with which I was associated for many years before retirement."

Harold M. Weddle writes, "We purchased the house that we were renting in Rancho Bernardo for a permanent home. After living in the San Diego area for the past 18 months, we feel that it is a great place to retire for year-round living." . . . **Lloyd W. Vickery** is enjoying his retirement as General Manager, Engineering Department of Continental Oil Co., after 40 years of service. For a hobby he has become an amateur rancher on 2640 acres of excellent bluestem grassland, located in old Kaw Indian tribal area, next to Osage County, Ok. "Most people", he continues, "would consider this a full-time job. There is not a dull moment."

Charles Frank, Jr., writes, "After studying and working for the past 50 years, I finally retired last July, having reached that magic age of 65. Now that I am a senior citizen, I feel like a new person, enjoying so many wonderful advantages. Instead of working 8 to 12 hours a day, six days a week at Raytheon Manufacturing Co., such as I did during the Vietnam war, and get a pay check, now I do as I please and more than glad to get a few retirement checks. During the past winter, I have been doing volunteer work with the local Red Cross Chapter on the blood donor program. On occasion, we drive or fly to Lynchburg, Va., to visit with my wife's relatives and friends. I do appreciate being remembered on my sixty-sixth birthday. Best wishes to all my classmates." . . . **William W. Young**, like many of our class members, has retired and is taking life easy. "We plan to attend the wedding of my oldest grandchild, which will eventually produce another generation. Jane had a bout with cancer last fall, but we both feel fine now and are looking forward to attending our 45th Reunion. See you all in June."

Professor Emeritus **Fred S. Eastman**, University of Washington, has sold his home in the Seattle area and moved to a permanent residence in Rossmoor, Walnut Creek, Calif. "My wife Mary was taken by cancer in 1971", he continues, "and I have made a new life now by marrying Mary's sister-in-law, Louise, who lost her husband in much the same way. I have just completed a study which I started many years ago, 'The Extraordinary Maneuvering Forces Attainable from a Wing in Ornithoid Motion.' I am enclosing an abstract, which is an approximate analysis that can be used to plan experimental work. So far the paper is unpublished. It should be used to

stimulate interest in the subject. There is a potential value here, and it just could become revolutionary in some ways, if it gets to the right people." If anyone is interested, I will be glad to send a copy of the abstract.

Roger A. Sykes has sold his home in Pennsylvania and is living in his Sunapee, New Hampshire summer home, which he renovated a few years ago. He lives there during the summer and Florida in the winter. "Took up living in a travel trailer in Largo, Fla., to see if the southern climate is for us. Have not decided yet, but when the gas situation gets better, we'll try to settle the issue. I still do a little consulting and committee work but lots of loafing. Regards to the gang."—**Karnig S. Dinjian**, Secretary, 6 Plaice Cove, Hampton, N.H. 03842

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This month we have reports from two ex-telephone men. **Dick Phillips** retired from the long lines department of A.T. and T. as of February 1, 1974. Last summer he and Evelyn and their 17-year-old granddaughter spent 10 weeks driving the Alaska highway and touring Alaska. Their route included Fairbanks, Seward, Valdez, Homer, Seldonia, Prince Rupert and the narrow gauge railroad from White Horse to Skagway. Dick says the fishing was fantastic, the scenery beautiful and that they saw many wild animals including grizzly bears. . . . **George Perry** spent most of the years 1930-1950 in Latin America—telephone construction and management in Colombia and mining in Mexico. For the last 24 years he has lived in Kansas City engaged in "the more prosaic and humdrum activities of property management." Because of their earlier experience, the Perrys are considering living in Spain or Portugal after George retires next year if "the levels of international exchange, the stock market, inflation and many other factors permit." As extracurricular activities George lists, in addition to more conventional items, bird watching and tape recording their songs. . . . **Henry "Pat" Pattison** retired as Chairman of the Executive Committee of Benton and Bowles, Inc., several years ago and is now living in Tucson where he is a consultant to the Director of Research at the University of Arizona. He has continued to be active "on all bands of ham radio" and has written several articles on radio centers. Since Pat retired, he and Mary have travelled all over the world, avoiding New York as much as possible. Their next trip will be to the Adriatic. Between trips Mary has completed her work for an M.A. in English literature at the University of Arizona.

In April and May, 1973 **Joe Kania** went on a trade mission with the Vancouver Board of Trade to Czechoslovakia, Poland, Hungary, Bulgaria and Romania. This spring he will go with the same group to Finland, Sweden, Norway, Denmark and England. He says that if any geology classmates get out his way he hopes they will look him up. . . . **Win Hartford** was one of 100 Boston University College of Liberal Arts alumni to be

honored at the Centennial Day celebration in Boston on March 30. He has been elected to the Collegium of Distinguished Alumni.

We have a notice at hand that **Clifford Hoar** died on November 9, 1971. Unfortunately no details are available.

Change of address: **Jorje I. Barnett**, Panama Gouit, Palacio Nacional, Panama City, Panama.—**Gordon K. Lister**, Secretary, 530 Fifth Avenue, New York, N.Y. 10036

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A thoughtful letter from one of **Juan Chibas** prep school teachers reports that Juan would be delighted to hear from his classmates. He is retired and is convalescing from a recent cataract operation in his right eye and reports that letters (but not books or newspapers) reach him about a month after being mailed from the U.S.A. His address is—Jon (Juan) E. Chibas, Calle G #573 Vedado Apt. 46, Havana 4, Cuba. . . . **John Spalding** writes that he is building a retirement home in Yarmouthport, Mass., and expects to retire in May, 1975. Meanwhile, John is busily engaged in a whole gamut of company activities and related community affairs. . . . Have spent several most enjoyable evenings with Hope and **Randy Binner** recently. Randy is enjoying his retirement and he and Hope are becoming quite some "Curlers". . . . Congratulations to **Lombard Squires** upon receiving the Robert E. Wilson Award in Nuclear Chemical Engineering for 1973.—**Edwin S. Worden**, Secretary, 35 Minute Man Hill, Westport, Conn. 06880; **John R. Swanton**, Assistant Secretary, 27 George St., Newton, Mass. 02158; **Ben W. Steverman**, Assistant Secretary, 260 Morrison Dr., Pittsburgh, Penn. 15216

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Dr. Rocco Petrone was recently named Associate Administrator of the National Aeronautics and Space Administration, with responsibility for the overall management of that agency's research and development programs. He will direct the activities of the Headquarters program offices, including Manned Space Flight, Space Science, Applications, Aeronautics and Space Technology, and Tracking and Data Acquisition. Dr. Petrone had been serving as Director of the Marshall Space Center, Huntsville, Ala., prior to his new appointment, and previous to that served as Apollo Program Director at N.A.S.A. Headquarters. . . . **Roger Zampell** reports the acceptance of a new assignment as the Chief Planner, Broward County Area Planning Board, Fort Lauderdale, Fla., and will be permanently located in one of Jackie Gleason's townhouse condominiums at the Inverary development after July, with the latchstring out after that date. . . . **Albert W. Dunning** advises the successful establishment and operation of a specialty powder coating business, based on high voltage electrostatics for electrical insulation and encapsulation of small electronic items together with a consulting service in this type of

activity under the name of Dunning Associates. . . . **H. H. Imray** was named President and Manager of Texas Eastman Co., last January.

A very pleasant and happy note from **Sidney B. Jeffreys** announcing a recent honeymoon trip at the El Conquistador Hotel at the eastern end of Puerto Rico. Congratulations and best wishes. . . . **George Warren Smith**, Secretary, Class of 1926, is looking for yachting enthusiasts among the alumni. He is spearheading a project to improve the M.I.T. Sailing Pavilion. Those interested should contact him directly at Pigeon Cove, P.O. Box 506, Mass. 01960.

It is with deep regret that I report the passing of **Murray G. Peterson** on February 14, 1974.—**John W. Flatley**, Secretary, 6652 32nd St. N.W., Washington, D.C. 20015

33

"The time has come", the Walrus said, "to talk of many things, of shoes and ships and sealing wax, cabbages and kings." The trouble is that there is not too much to talk about this time around; 3 or 4 items from personal sources, plus the press and Fund capsules.

However, we can fall back on the Mexico City M.I.T. Club Fiesta. What with the large and successful 25th Anniversary of the Club last year, attendance was light this time, as was expected. **Prentiss Lobdell** was the only classmate present, accompanied by his lovely Marjorie, plus W.J.H. (part time). It was unfortunate that I had to be in New York City the day of the annual luncheon, so I flew to Mexico on Friday, took in the Saturday visit to the Mexican Nuclear Center of Salazar, with a splendid luncheon at the lovely "La Escondida", 200 feet down in a mountain gorge. Noche Mexicana was held at the "Nish" Cornish (and Luisa) Hacienda. This is always the highlight of the Fiesta. Lobby was very much in evidence, but was too busy lapping up that fine Mexican food, preceded by several Margaritas, Tequila Sours, et. al., to the music of a fine concert by three Mexican impressarios, one world famous. Lobby won't get over that evening for a long time. Incidentally, Lobby and his lovely are already moved into their new condominium on Longboat Key, Sarasota. One added plug, please; if one has any desire to visit this lovely country, Fiesta time is the time to do it, either the Fiesta by itself, or as part of a longer Mexican trip. The one feature which makes this sort of trip to a foreign country is the fact that you visit Mexico City with a large group of fellow Alumni, all with one thing in common, M.I.T.! You just hafta know someone, or you sure as heck will after a few minutes at the annual luncheon. The boys added a fine feature this year; a post Fiesta three-day trip to Oaxaca, Monteban and Mitla, all south of the city. So Lobby got in six days of fun and games, and best of all, among friends.

We have a circular letter from **William (Bill) Harper**, telling us that the new Clinic dedication has had to be postponed because of unprecedented flood

conditions. Bill says that the new Clinic and Research Center of Texas Chiropractic College is really something else, and asks that we all plan a visit, later, if not at the formal dedication. . . . We have a note, with enclosures, from **Cal Mohr**, of whom there is none more, with some gossip on '33 men. . . . **Walt Swanton's** trip to New Zealand and Australia was mentioned but this was carried earlier—see May issue. . . . It appears that **Andy Regan** has been promoted to the position of Manager of Purchasing at Tennessee Eastman. Let's have the story, Andy, what? Cal shows evidence of age; he and Jean have moved from the big house in North Aurora, to an apartment in Aurora. This move indicates advancing years; I do hope I never get that old. Cal also reports via a clip that **Bob Smith's** father, a dentist of distinction, has passed away. We had a story about this remarkable fella long since, so will not comment further: except that he really was quite a guy. We offer our sympathy, Bob. . . . Cal also included a clip on **Morris Cohen** and his connection with "Cosmat", a coined word which signifies the National Academy of Science's committee on Materials, Science and Engineering. Morris is Chairman of this 23-man committee, which is accumulating material to do with materials, resources, substitutions, recovery and recycling, and national material needs in general. You will recall that Morris is Ford Professor of Materials Science and Engineering. Good stuff, Morris. How is this for an unpaid P. R. job? You could pay me by writing to me, personally, once in a while.

In the same general category we find the irrepressible **Dick Morse**. Readers of the *Wall Street Journal* may have seen a full column on Dick's steam car research, for Chrysler. I did not and do not know when it appeared. Added to our previous information on Dick's activities, we may now add that, aside from his part-time lecturing at the Sloan School, Dick is also President of the M.I.T. Development Foundation, Inc., which raises venture capital to exploit the technological advances of M.I.T. Golly, our Institute really knows how to pick their men. We have reported before on Dick's work on the steam engineer for motor cars, so we have no great need to repeat, except that it is now reported that an experimental Dodge Polara is now being tested which is able to equal the M.P.G. rating of the gas Polara, with very short time warm up and many weeks of operation using only eight quarts of water. And the emission problem is, apparently, really licked. The steam engine is quite a bit heavier than the Polara's gas engine. This fella is really getting someplace. Well, he is one of our brighter men so I hope that we do not hope for too much all at once. I wonder how many of our classmates, besides me, has ever ridden in a Stanley steamer. I did when I was about 10 years old, in a Stanley owned by one George Percy, M.D.; our then next door neighbor. Trundy, the all around chauffer and handy man, took me for a ten minute flight (?) on Mass. Avenue, Arlington. If there is anyone else who has ridden in a Stanley, please let me know.

We have a full page release on **John Long**, from whom we hear occasionally. John, in a recent meeting of the stockholders of the Metalized Ceramics Corp, Providence, R.I., was elected Chairman of the Board and Chief Executive Officer. This, according to John, amounts only to a realignment of responsibility. Among other things, MetCeram is working on a plating process for plating gold on its products, but with an 85 per cent saving in gold use.

In the May issue we mentioned that **Steve Crick** has passed away, so we wrote to **Neil Hopkins** and **Al Moeller**, longtime friend of Steve's. Hoppy was amazed to hear about Steve and will write to the widow, as I already have. He tells me that Ruth's partial incapacity is about the same and she gets around a good deal via walker and wheel chair. Further, she can ride in the auto and has been all over with Neil, and enjoys it. And as one might expect, Hoppy makes with the pots and pans, and well. (Dinner guests have been known to ask for seconds) Perhaps the guy is bragging. Just as an aside, he grows all the family vegetables, and further, finds time for working with the York, Pennsylvania Hiking and Biking Club. He is disturbed by the evident vanishing fossil fuels, and avers that we soon may be back on the farm, following the horses. . . . Again, in a reply to mine about Steve Crick, Al Moeller writes me for the very first time, I think, and if one considers how close we four were in 1930 to 1933, it is heartening. One of us is gone, and we shall miss him. Al has retired from the administration and distribution of his grandfather's estate, as Trustee since 1940. Daughter of the house is a graduate of Duke, '69, and is living in Gunnison, Colo., with her husband who, in turn, is finishing up his education at Western Colorado State; interested in conservation. They have a 17-month-old son. And they have a horse, three dogs, and a few tame mallards, useful in egg production, no? Christine and Al fly out there summers, but not winters as it gets too cold there (40 below). Haw. I have seen it 45 below in New England and I didn't fly to it either. Thanks, Al and Christine, for your nice letter, and Leona also thanks you for your best wishes to her.

Now, another part of the Crick story. When we reported before we had news only that Steve had passed away. Now the press comes through with the story that Steve and a friend were killed in a small plane crash near the Detroit Metropolitan Airport. The two were making a routine instrument landing during a storm, with Steve at the controls. The plane was a twin Beechcraft, and visibility was ample for instrument landings. The cause of the crash has not yet been determined. We are assured that both men in the plane were capable pilots, both visible and instrument, with many years piloting small planes. That's it. I hate like all heck to write such proceedings but it must be done, and I have written Betty, as I hope that a few others of you will too.

From **Carl G. W. Swanson** comes an Alumni Fund capsule telling us of Carl's

retirement, and hence a move to the hinterlands; Newtown, Conn. Carl was with Burns and Roe, Inc., of Hempstead, N.Y. Apparently a move to an apartment involves more than meets the eye. When you read this Carl will be established but the new address is so far missing. Carl wants to hear from classmates in and around Danbury, so give him a ring when you read this.

We have one more sudden passing of one of ours: **John E. Logan**, (a next town Florida neighbor). John passed away on March 15, 1974, as recorded by the Alumni Register. In spite of living close by, we have no details. We will write Dorothy, his widow, who has visited us in our home. To all the survivors we wish to express our sympathy on behalf of our Class.

Golly, two more Fund capsules just came in; **Converse W. Sweetser** is brief and to the point "Retired from Grumman." Brother Sweetser, there are 7 lines on the capsule and you could have said more. . . . I must quote **Walt Swanton** as he does a real job of saying so; "Was in Tasmania week of December 9 to assist in the start up of another Pfadler Industrial waste recycling system. Week of December 2, called on our Australian personnel on prospects in Sydney and Melbourne. Stopped in some of the New Zealand scenic areas on the way home, and had the pleasure of meeting Dr. Daniel Ellsberg at Milford Sound. Also fortunate in seeing Mt. Cook under most favorable weather." Walt, you were luckier than we last February. We saw other fine mountain views but not Mt. Cook. Many thanks and good luck, Walt.

Another shorty. **Don Fink** was one of eight elected to the Board of Directors of the Institute of Electrical and Electronic Engineers, Inc. (I.E.E.E.). Golly, I thought he owned the place anyway. He is and has been General Manager for some long time. By golly, Don, you will make it for sure one of these days. Our congratulations.

The following are changes of address; William W. Laird, Calvin H. Mohr, Henry A. Rahmel, Dr. Harry G. Steinman, Clarence R. Westaway. These changes are available under the usual conditions; no reply unless the request contains a short story about your family. . . . That winds it up for this time around. We wish y'all a pleasant summer. Please note summer address of Secretary in case you wish to drop in for a quickie. Leona joins me in asking you to please stop in. Best wishes.—**Warren J. Henderson**, Secretary, Fort Rock Farm, Drawer H., Exeter, N.H. 03833

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Continuing last month's travelog I have the second half of **George Bull** and Mary Elizabeth's travels. We left our hero and heroine in New Zealand, about to leave for Australia. George says Australia is now quite stuffy about who gets in—a visa, extra photos, return ticket and a passport that is good for six months after you say you are leaving. Then they check your name against a list (of possible undesirables? Just like the U.S. does.)

There had been recent severe floods in Queensland and they attended a concert for the relief of the sufferers. It turned out to be a very noisy pop concert and a friend remarked, "At least the flood victims didn't have to come to Sidney to listen to this." Sidney and Melbourne are clean, modern cities, Canberra, the created capital, a beautiful city planned by an American and with a present population of 150,000. George wondered how it will be able to stand up to the Washington type sprawl.

They went on to Alice Springs in the "outback" and found it like a typical western. It is in wild rocky and sandy country and there are some roads. Flying is the principal means of transportation. From the outback George and Mary flew to Cairns to see some of the Great Barrier Reef. En route he says the plane stopped at a big copper mining complex of Mt. Isa. A neat company town—no sign or smell of sulphur dioxide fumes (no vegetation to be bothered by it anyhow). George says, "I am sure our copper king **Frank Milliken** is very well acquainted with the place."

The Barrier Reef seems to have been a disappointment—so much under water. But a glass bottom boat shows a fabulous variety of sea life and fishes of all types of color schemes.

The last stop was in Fiji—famous for firewalking and they saw one of the performances near the capital Suva. The origins of the ceremony are still unknown but it is performed only by men from Bega, an island in the Fiji group. Legend has it that a man from Bega once caught a fish that turned into a dwarf with magical powers, who promised to show the man how to walk on hot coals without being harmed. The preparations sound a good deal like those for a New England clambake. Red hot stones are raked into a level area, about the size of a nine foot by twelve foot carpet and when the stones are still very hot, if no longer glowing, several men take turns walking steadily over the rocks. George said there was obviously no hanky-panky, no burnt feet; and as far as he was concerned, no good explanation.

After all of this, a return to Los Angeles must have seemed tame, but there was the pleasure of a week with their daughter and the thrill of the local equivalent of fire walking—Los Angeles traffic.

And now to **M. E. Rich Richardson's** report on '34 in Georgia. He mentions that in the Atlanta area besides himself there are **Brad Hooper**, **Ernest Lockhart**, and **Bill Spreen** and over near the coast, in Jesup, **Earl Murphy**. "Rich" goes on to tell that his life-time career has been in the material handling and material management fields, in industries in both the Philadelphia and Atlanta areas. "Business affiliation has included both manufacturers and users of conveyors, rack and storage systems, warehousing and distribution methods, packaging and special engineering projects. Currently my assignment is that of Manager of Materials Handling, working as a full-time consultant for Coats and Clark Inc., the "thread" people. Previous corporate affiliations have included DuPont Continen-

tal Distilling (Why ever leave a company like that?), Yale and Towne, Rapistan and American Chain and Cable. Hobbies and personal activities include color photography, sailing, and teaching with the U.S. Power Squadron and the Coast Guard Auxiliary. The chartering of a 35-foot cruising sailboat in Maine, Martha's Vineyard and Nantucket have been highlights of our ocean sailing vacations over the years. Other cruising includes the west coast of Florida, Chesapeake Bay and South Carolina and Georgia."

His wife Eleanor is very active in civic, church and community affairs, including the presidency of the Georgia State League of Women Voters. A daughter, Meryl, graduated from Mary Baldwin College, is married to Gil R. Nolan, '58, and lives in Acton, Mass. Her two sons, 10 and 6, both play Little League Ice Hockey and "Rich" quotes a local fan about the Atlanta Flames (who brought the Ice Age to Atlanta), "Southern grits and Northern guts can make a good team."

He winds up, "By the way, Eleanor and I were in Brewster last September '73 revisiting the Brewster Mill (He should have stopped by, I'm only three quarters of a mile from it) and the beach at Monomoy Camp for Boys. The house across the street, 'Linger Longer by the Sea' brought back courting memories of the early thirties. From the scenic outlook of the Mid Cape Highway you can see my six and one half acres and concrete block goat house on the far shore of Wequaquet Lake. For your information, it is for sale."

Sorry, "Rich", you should have tried **George Fichett** before he moved from the other side of the lake, but thanks for the newsy letter. Ones like this are always appreciated.

I had hoped to escape one issue without having to tell of the loss of another classmate but it was not to be. In January **Floyd Carpenter** of Walnut Creek, California, died. I have no further details but express our sympathy to his family.

As I promised last month, I have a few Alumni Fund notes. **Ernie Massa** writes, "Since moving to Florida (Pompano Beach) several years ago, we do not see as many classmates as we used to when living in the Boston area. Jeanette and I hope to renew acquaintances this summer at our 40th Reunion—see you then." I can see I'm going to have to try and find time to put together a list of members of '34 who have retired to Florida. The woods (or swamps) are full of them. The only problem will be keeping it up to date. Maybe we can find one of them to help as another Assistant Secretary.

We apparently have another active Power Squadron member because **Charles A. Wesley** says, "I have retired from Perkin-Wilmer, my main occupation now being photography and teaching navigation. Alice encouraged my camera work, which had a low priority until the children were self-sufficient. Alfred is completing a home in Oregon for his family, which includes our only grandchild, Sesame. Margo is travelling in Europe and Africa, David, an electronics engineer, is nearby."

George R. Struck sends a brief note—"Retired June, 1972, Eastman Kodak Co., Assistant Vice President, Radiography Markets Division." Unfortunately, no word about present activities but my address print out says that George is still living in Rochester. If that's correct, he didn't chicken out the way **Phil Kron** did and run away to the South. . . . Honors continue to come to Canadian women members of our Class. If you go back over these Notes through recent years, you will find they have received enviable recognition. **Eloie G. MacGill** writes, "In June, 1973 I received the Julian C. Smith Award (for achievements in the development of Canada) at the Engineering Congress of the Engineering Institute of Canada, at Montreal." Congratulations seem well due for these awards.

Finally, along with his reunion registration, **Charles F. Barrett, Jr.**, sent a little news. He said, "I retired from General Electric in June, 1972 and we spent the next year travelling around the U.S. in our camper. Last year we spent about six months at home in Saratoga Springs and then came to Florida for the winter by way of Boulder, Colo., where we were for Christmas and New Years. This year we have a travel trailer so we have had more room. "My wife Amalia (nickname Lee) has been busy getting outfitted for the reunion. She figures that Florida fashions will be suitable for the Cape in June!" I hope she won't be disappointed but last night (April 19) the dew on the ear froze. However we've over five weeks to go and that can make a big difference.—**Robert M. Franklin**, Secretary, Satucket Rd., Brewster, Mass., 02631; **George G. Bull**, Assistant Secretary, 4961 Allan Rd., Washington, D.C. 20016

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The biggest and best news of all is that our 40th Reunion Chairman, **Rufus Applegarth**, was married on February 23 to Miss Anna Rex in Coleston, Penn. They are now living at "La Casita" 202 Montgomery Ave., Coleston, Pa. 19401. Very best wishes from all of us to the happy couple.

A note came through the Alumni Fund office from **John C. Alden**, "My wife Anna is busy in the State Education Department in Boston. My four sons are now in various activities: John the oldest is with Aubuchon Hardware Co., Peter with the Massachusetts Audubon Society, Dave with the Charles T. Main Co., and Carl at the Fernald State School." . . . **George R. Bull, Jr.**, reports that he retired from the Bell Telephone Co., of Penn., on March 16. Now that you have some time, George, please write and tell what you were doing before and what your future plans are; also a word about your wife and two sons. . . . An issue of the *Wayland Town Crier* reports **Stanley Alexander** is now entitled to the nationally recognized professional designation G.R.I. (Graduate, Relators Institute). Both Stanley and his wife Lois are associated with Barbara M. O'Brien Realtors of Lincoln. Stan was on the staff at MITRE and previous to that spent 11



Arthur F. Gould, '38

years in Washington, D.C.

Class of 1935 had strong representation at a recent M.I.T. Club of Boston Luncheon with **Chester Bond**, **Peter Grant** and **Allan Mowatt** present. The Fourteenth Annual Class Golf Tournament is going strong—if any of you who enjoy the game have not been in this, you should try it and it is not too late to call me and start NOW.—**Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

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I regret to have to report the death on April 2, 1974 of **Webster Wilson**. My latest information lists him as a consultant in New York City and no further details are currently available. . . . I can further report that no other members of the Class attended the Mexican Fiesta in March. You all missed a good show.—**Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, Conn. 06091

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Dave Fulton has a new job as Vice President of S. D. Plants, Inc., 2 Park Avenue, N.Y.C. He also has a new wife, Gaye, as he was married on January 15, 1972 and a new daughter Jennifer, born May 3, 1973. Congratulations, Dave. . . . **Ray McFee** is now living at 5163 Belmez, Laguna Hills, Calif. 92653. . . . **Joe Heal** had just returned from Florida where he is selling his land in the Keys and has a new location in West Palm Beach. . . . **George Tapley** writes that he "reached 72 years of age on March 15, 1974. I am a Congregational Man born in Rockland, Maine, which makes me an official Penobscot Clam Flatter. I have just received my 32 year consecutive 100 per cent attendance Bar from Brookline Rotary, Mass. Frances and I have no children of our own but slews of local rascals. Frances is a big shot in D.A.R., C.A.R., D.A.C. and an eminently successful genealogist of international repute. If

anyone is in this neck of the woods drop in, you're welcome."—**Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, Mass. 02155; **Les'er Klashman**, Assistant Secretary, 198 Maple St., Malden, Mass. 02148

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Jim Emery writes, "After five years in consulting work with Simpson and Curtin in Philadelphia, have moved back to Baltimore. I am working on the development of transit systems in Maryland's smaller urban areas, and on the state program to support railroad commuter service between Baltimore and Washington and between Brunswick, Md., and Washington. Also handling relations with U.S. Urban Mass Transportation Administration" . . . **Burt Grosselfinger** dropped a note, "Appeared in a scene with Peter Boyle in the film 'Crazy Joe' and on the C.B.S. 'The American Parade'. Was elected a Director of Fecor Industries Ltd., a steel fabricator of York, Pa." . . . Our Class President **Norman Leventhal** has gotten heavily involved in the new Boston Visual Union New Gallery. Norman has contributed the space together with a substantial portion of the construction cost. If you are in Boston, the Gallery is well worth visiting at Three Center Plaza, Government Center. . . . Congratulations from the Class to **Arthur Gould** who was nominated to receive the certificate of Distinguished Engineer by the Lehigh Valley chapter of the American Institute of Industrial Engineers. Norm is presently the Alcoa Professor of Industrial Engineering at Lehigh University.

Dick Henderson has informed us that **Chet Lawrence** died suddenly this winter. Chet's office had been down the hall from Dick Henderson's at Olin Mathieson. We express our deepest sympathy to Chet's family.—**A. L. Bruneau, Jr.**, Secretary, Hurdman and Cranstoun, 140 Broadway, New York, N. Y. 10005

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Presumably by the time this issue reaches your mailboxes, our 35th Reunion will have come and gone, with those who attended very well pleased with all the arrangements, and those who couldn't make it, wishing that they had! What more can be said in an April writing? Well, the following can be written about it, and truly, for in answer to my letter expressing the hope of the Class that he could attend for all or part of the festivities, Massachusetts **Governor Francis W. Sargent** replied: "As far as the reunion goes, it looks highly unlikely at this point that I will be able to attend. The Republican Convention is June 1, and the National Governors' Conference convenes in Seattle on June 4, leaving little time for much else just then."

In his letter, Frank continued with some highlights of his family. "Jessie has become an author in the past year with the recent publication of *The Governor's Wife: A View from Within*. The book gives a good indication of how much

she's accomplished over the past few years. She's done a tremendous job in expanding the responsibilities of a governor's wife.

"Fay and **Jamie (McLane)** is still in Washington where Jamie is second in command at the Cost of Living Council. Bill has been producing some films, and this summer will be participating in the Law of the Seas Conference in South America. And Jay and **Brian (Flynn)** are affiliated with the Pine Hill Riding Academy in Southboro, Mass." . . . **William Christensen** has been named Manager of Project Engineering and Construction, for Hershey Foods Corp., in Hershey, Penn. Bill, a registered professional engineer, came to Hershey in 1965 as construction supervisor for the construction of the Milton S. Hershey Medical Center of the Pennsylvania State University, and was later named Manager of Construction of Hershey Foods.

For those who can delve into the higher world of high energy physics, look up *Science* for February 15, 1974 and read Dr. **Richard P. Feynman's** nine and one-half-page article on the "Structure of the Proton." Dick is Professor of Physics at the California Institute of Technology, in Pasadena. This *Science* article is the text of an address given at Dansk Ingeniørforening, Copenhagen, Denmark, on October 8, 1973. Learn all about pions, hadrons, gluons, and quarks!

For his contributions to physical electronics, radio telemetry, and research in upper atmosphere phenomena, Dr. **Myron H. Nichols** has been elevated from the grade of member to the grade of Fellow, of the Institute of Electrical and Electronics Engineers, as announced by the Board of Directors of the I.E.E.E.—**Oswald Stewart**, Secretary, 3395 Green Meadow Circle, Bethlehem, Pa. 18017

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Fred Port, President and Chief Executive Officer of E.S.B., Inc., of Philadelphia, has been elected to the Penn Mutual Life Insurance Company's Board of Trustees. Fred received his doctorate degree in chemical engineering with us. . . . **Ted Gundlach** notes, "Moved to within two miles of work to help energy situation on Dick's advice—mostly wear and tear on my nerves. First grandson, Jonathan, born to Dr. and Mrs. T. J. Gundlach, III, of Irvine, Calif."

Further details have been received from **Gary Wright** on his world trip and other activities: "Last April I ran for the position of Councilman at Large for the City of Springfield (Mo.) and came out the successful candidate, that is, I won; I'm not sure about being successful. The job is for love and satisfaction but nothing more. It is interesting but takes a world of time. I have turned over the company and operation of Wright and Associates, Inc., to younger engineers who worked with and for me a long time. So I am theoretically retired for the second time. Temporarily? On November 20, 1973 my wife, Marion, and I left for a trip around the world covering Senegal, Kenya, Zambia (where we

Safeguards to Privacy: the Governor and his Advisers Speak

Despite considerable federal pressure, Governor Francis W. Sargent, '39, is keeping Massachusetts out of the data bank of the National Crime Information Center.

The problem, he says, is that the national system lacks adequate safeguards—"to control what information may go in and who can gain access to it."

Massachusetts has its own computer-based statewide system to keep track of criminal history records. "We provide full access to this information to all agencies engaged in combatting crime," Mr. Sargent noted in a statement last year to announce the state's decision to stay out of the federal system. But "we are careful to prohibit access by individuals or organizations who could use this information for inappropriate purposes."

"We still believe that those persons found innocent of a crime in a court of law are not to be considered criminals," Mr. Sargent said.

In his decision Governor Sargent had the advice and counsel of a state Commission on Privacy and Personal Data, appointed especially to advise on the implications for citizens' rights of the state's computerized record-keeping and information-gathering systems. Jerome B. Wiesner, President of M.I.T., and Robert M. Fano, '41, Ford Professor of Engineering—both experts in computers and their implications for information-collection and privacy—were among the charter members of the Commission; now Mrs. Serena Modigliani, whose husband is Franco Modigliani, Institute Professor in the Department of Economics and Sloan School of Management, has also been appointed, as a "public" member of the group. "It is a fascinating—and important—subject," she told *Tech Talk*; "we are being surrounded by intrusions from every side."—J.M.

visited our daughter and family), Mauritius, Australia, Hawaii and back home. We were gone 49 days and nearly all it was in the southern hemisphere where it was warm and sunny. Arrived home, however, in six inches of snow and not very pleased with the Missouri weather. We now have four grandsons: Matthew, Mark, Luke and (you guessed it) Andrew. We will hope to make the 35th Reunion, God willing, and will be enthusiastic whatever is decided. Yes, we would be most interested in the Yucatan trip but would not limit our attendance to that suggestion." Write Al.—**Alvin Gutttag**, Cushman, Darby and Cushman, 1801 K St. N.W., Washington, D. C. 20006

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Reece Wengenroth, Executive Vice President of Westenhoff and Novick, Inc., Chicago has been named to the Jury of Awards of the American Institute of Steel Construction, Beautiful Bridge competition. This is an annual event in which prizes awarded are to builders of steel

bridges located in the United States who are creating better aesthetics in bridge building. . . . **Frank Seeley** writes that things look even better than usual in sunny Miami and invites visits from any old friends and classmates. . . . **Mike Hook's** daughter, Dianna, will be awarded her L.L.D. in Jurisprudence from Hastings College in San Francisco this May.

Class news is at an all time low! Please save me from having to send mailings and questionnaires to all and sundry by sending some news to me NOW!—**L. K. Rosett**, Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

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Dr. B. David Halpern has been elected President of the Association of Consulting Chemists and Chemical Engineers, Inc., for the year 1974. Dave, who resides in Rydal, Pa., is President of Polysciences, Inc., and is also an independent polymer and chemicals consultant, specializing in bio-materials. He is a former Research Director of Borden Chemical Co. . . . Maryland State **Senator Newton I. Steers, Jr.**, a Yale man who accompanied our Class for a couple of years, is being mentioned as a potential gubernatorial candidate. He distinguished himself as an able government leader from 1967 to 1970 when he served as Maryland State Insurance Commissioner. He is a Republican, by the way.

Ken Wadleigh forwarded some additional news of **Jim Reswick**, whose accomplishments were described in last month's Notes. Trudy and **Jim Hoelzerkopf** were married in December, 1973. A citizen of West Germany, Trudy is a registered occupational therapist at the hospital where Jim directs the rehabilitation engineering center. . . . Professor **Wilbur B. Davenport, Jr.**, who received his master's with our Class, was appointed to Professor of Engineering and Education in the School of Engineering at M.I.T., Acting Director of the Center for Advanced Engineering Study, and Head of the Department of Electrical Engineering.

News of some classmates who were graduate students with us: **Klay Wilcox** is a staff scientist with G.C.A./Technology Division, G.C.A. Corp., Bedford, Mass., where he is working in air pollution control, especially those from automobiles. . . . **Muriel B. Wilbur** is now Adjunct Professor and Coordinator of Health Care Administration at Babson College in Wellesley, in addition to being Health Educator in the Brookline, Mass., Health Department. . . . And **Stewart G. Fletcher** left Latrobe Steel Co., after 28 years, the last 17 as Vice President and Technical Director, to accept a position as Senior Vice President of the American Iron and Steel Institute in Washington, D.C.

This June will be my second anniversary of living on the west coast. I am enjoying the practice of law here. The weather is ideal all year long, which makes golfing and boating every weekend very pleasurable. My daughter will be starting San Diego State University this September, majoring in art, and my son will be a junior at the University of Cali-

fornia at Santa Barbara, majoring in physics and math. A non-controversial marriage dissolution in April finds me becoming acquainted with the vicissitudinous qualities of bachelorhood. A happy summer to all, and please call me when you visit southern California.—**Richard M. Feingold**, Secretary, 3757 State St., Santa Barbara, Calif. 93105

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Tilt! Thirtieth Reunion site detailed in the last issue in error. Within days of the April-May deadline, Reunion Chairman **Jerry Quinnan** called to advise that Chatham Bars Inn in Chatham had been signed as our Thumping Thirtieth Headquarters. If the truth were to be known your Secretary considers this an excellent choice—far superior to the location we tried to sell last month. Chatham Bars is an M.I.T. tradition! Reunion details will start to flow in the fall.

George K. Landon, Jr., of New Canaan, Conn., has been named Vice President and General Manager of the Plastic Container Division of Continental Can Company. "Daper" joined Continental in 1946 at Bond, Crown and Cork advancing through the organization to become Plant Manager in Chicago. He later transferred to the Flexible Packaging Division and became Manager of Manufacturing in 1963. He went to the Bondware Division in 1966 and returned to Flexible Packaging first as General Manager, being named Vice President in 1970.

Walter O'Connell is now in Exton, Pa., so advises **Ray Pelley** of Cincinnati. As Ray so aptly states one could have made a good living just moving the worldly goods of the O'Connell and Red Harrington families around the country these past 30 years. Yes, Ray expects to be a reunion attendee. . . . **Nelson Chang** was elected a Senior Vice President of Hayden Stone last December. . . . **George M. Berman**, a co-founder of Unitorde Corporation in 1960, was elected Chairman of the Board in early January. George continues as President and C.E.O. Prior to 1960 George held various engineering and market positions with the Electronics Division of Baldwin-Lima-Hamilton and other electronic firms.

Dave Mintzer is Vice President for Research and Dean of Science, Northwestern University, Evanston, Ill. Last December, Dr. **H. W. Mergler** was appointed to the Leonard Case, Jr. Chair of Engineering at Case Western Reserve University in Cleveland. Colonel **Donald L. Campbell** retired from the air force in April after a 31-year career. Dottie and Don have settled in Colorado Springs at the base of 14,110 foot Pike's Peak to enjoy their cross-country ski kick.

Have a great summer and drop us a line from your favorite vacation spot.—**C. H. Springer**, Secretary, P.O. Box 288, New Castle, N.H. 03854

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Dr. Edward H. Bowman, Professor of Management at M.I.T.'s Alfred P. Sloan School of Management, will become Dean

of the Ohio State University College of Administrative Science next September. Dr. Bowman is an internationally known management authority especially with regard to the ways universities invest their funds. In September Dr. Bowman will be returning to the campus where he was an instructor from 1949 to 1952 and where he received his Ph.D. degree in 1954. He was a professor of management at M.I.T. from 1952 to 1966, was Comptroller and Senior Research Associate in Administrative Science at Yale University from 1966 to 1969 and returned to M.I.T. as a professor of management in 1969. He was Director of the Sloan School's Doctoral Program from 1961 to 1963, Chairman of the Operations Management Faculty at the Sloan School from 1965 to 1966 and since 1971 has been Chairman of the School's Policy Faculty.

Nice note from **Douglas L. Crinklaw** advises he is working as an engineering specialist for Litton Data Systems Division. He says his job is very interesting and challenging. Is enjoying civilian good life. Doug's wife, Emily, is now busy taking part-time college work. Doug's son, Douglas, Jr., is an ensign in the navy and is Communications Officer on the U.S.S. *Finback*. Doug's daughter, Donna, is now a sophomore at California Lutheran. We extend sincere apologies for our error in the May 1974 *Technology Review*—Class Review. We mistakenly reported **Frank T. Westcott**, '46 as deceased instead of his father Frank T. Westcott, '22.—**Ed.—Russ Dostal**, Secretary, 18837 Palm Circle, Cleveland, Ohio

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The family and I are about to leave for a visit to my wife, Gina's, birthplace of Panama so these Notes will be even shorter than usual. Professor **Kevin Lynch** of the Department of Urban Studies and Planning has been awarded the 1974 Allied Professors Medal of the American Institute of Architects for his work in urban design and environmental planning.

The clipping services also advise that St. Regis has consolidated their Sherman Division into the Laminated and Coated Products Division with **Kermit Greene** named General Manager of the consolidated division. It would appear that Kermit will be moving from Newton to Attleboro. . . . I.E.E.E. has elevated **Paul DeMellow** to the grade of Fellow for his work in simulation of power system phenomena and its application to practical problems of design and operation.

The lack of correspondence essentially forces these notes to be brief so why not drop a line.—**Dick O'Donnell**, Secretary, 28516 Lincoln, Bay Village, Ohio 44140

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Harry Ottobriani was named President and Chief Operating Officer of Metalized Ceramics of Providence, R.I. Harry was a founder of MetCeram in 1960 and succeeds John A. Long who has been President since 1963. MetCeram can plate

gold selectively on metal-oxide semiconductor packages which have varying degrees of complexity and size. Sales for the quarter ending December, 1973 were \$3.08 million. Harry and Eleanor live in Wellesley, Mass.

James T. Smith is Corporate Vice President of the Magnavox Co. James is Vice President and General Manager of their Fort Wayne Division. . . . **Ed Kratovil** joined the Million Sales Club of American Hospital Supply Corp., during 1973 . . . **Mike Kami** has published *Corporate Management in Crisis: Why the Mighty Fall*. Mike's book received a favorable review in *Business Week*. The book twits the tail of the corporate establishment for which Mike worked for so many years. Mike has received a few phone calls from classmates to address M.I.T. meetings to raise some money. Mike is glad to do whatever he can within his schedule (as long as it does not interfere with fishing). Mike has kept himself mentally stimulated while earning an Ed.D. from Florida Atlantic University.

It is with great sorrow that I report a letter from the father of **Thomas George Swallow** informing us that George has died. George was ordained a priest in the Episcopal Church in 1958 and had served churches in western New York and in Florida before becoming Rector of St. Luke's Church in New Orleans, which he served for ten years. George received a master of arts degree in 1968 from Louisiana State University in New Orleans. He had nearly completed work at Tulane University for his doctorate at the time of his death. At the time of our 25th Reunion, George wrote to me and explained that illness would prevent him from attending. He asked to be remembered to his friends and sent his best wishes to everyone.

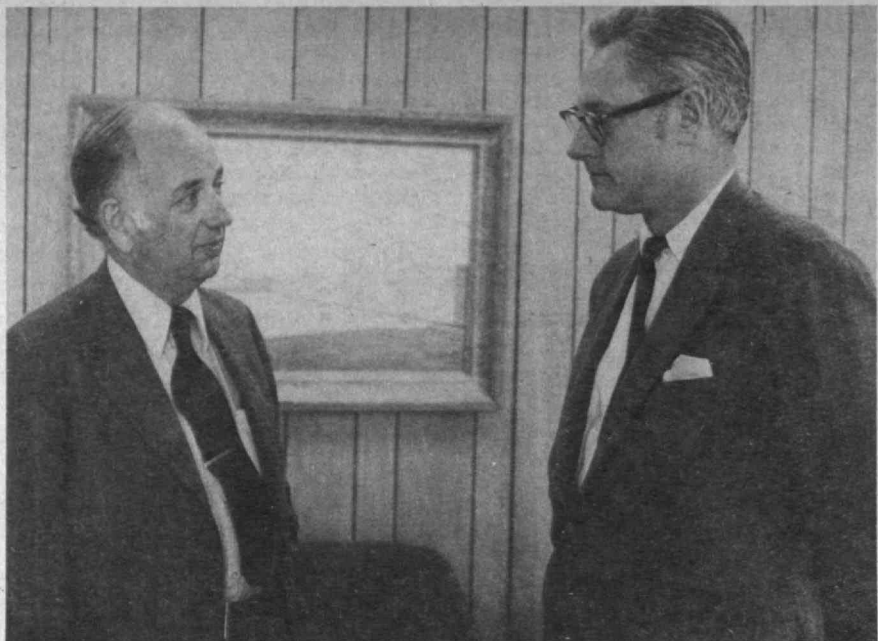
The \$10,000 Dickson Prize for the most outstanding contribution to science during 1973 was awarded to organic chemist **Elias J. Corey** by Carnegie-Mellon University. Dr. Corey is Professor of Chemistry at Harvard. His contribution was to the theory and practice of organic synthesis; particularly rare and valuable drugs such as the prostaglandins. . . .

Dan Fink was installed as twelfth President of the American Institute of Aeronautics and Astronautics. Dan is a Vice President of the General Electric Co., and General Manager of their Space Division. The Space Division employs about 6000 persons at 10 locations throughout the country.—**S. M. Billett**, Secretary, 16 Greenwood Ave., Barrington, R. I. 02806

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Franklin R. Kellogg is teaching math at Johnson State College. Franklin tells us he has four daughters and sundry barnyard animals and a wife.

After 23 years with Lockheed Missile and Space Co., **Richard Holmberg** has accepted the position of **Vice President of Engineering** with International Signal and Control Corp., in Lancaster, Penn. He is now getting reacquainted with east coast living, after 10 years in the San Francisco Bay area. . . . **Sterling G. Brisbin**, P.E., has recently been ap-



New Corporate Officer Herbert Benington, '50, (right) recently named Vice President of MITRE's Washington Operations met with President Robert Everett, S.M.'50.

Herbert D. Benington, '50, former Deputy Director Defense Research and Engineering, Office of the Secretary of Defense, joined MITRE in recent months.

President Robert R. Everett, S.M. '43, said that Mr. Benington would be located at Washington Operations reporting to Senior Vice President Charles A. Zraket. His initial responsibilities will focus on new efforts in both the civil and defense sectors. Mr. Benington has more than a decade of service in a number of key positions in the Defense Department. Most recently, he has served as Deputy Director for Plans and Assessments as well as Information and Space Systems.

His governmental career began in 1963 when he was employed as a Technical Director of the Joint Command and

Control Requirements Group in the Office of Joint Chiefs of Staff. In 1965, he was made Director for Command Control Communications and Intelligence in the Office of Assistant Secretary of Defense for Systems Analysis.

In 1969 he was Assistant Director for Command and Control in the Office of the Director of Defense Research and Engineering as well as Acting Deputy Director, Defense Research and Engineering, Office of the Secretary of Defense.

Prior to this Mr. Benington worked on the SAGE Air Defense System at M.I.T.'s Draper Lab, at the RAND Corporation and at the System Development Corporation where he was an Associate Division Head.

pointed Adjunct Associate Professor at Cornell University, Ithaca, N.Y., where he is teaching an industrial waste engineering course for graduate students. As a partner of Stearns and Wheler, Civil and Sanitary Engineers, Cazenovia, N.Y., he will also continue his engineering practice. Sterling, who resides with his family in Cazenovia, is also currently serving on the Education Council of M.I.T., assisting potential college students in their selection of schools.

Thomas C. Buchanan has just been appointed General Sales Manager of the Milford Rivet and Machine Co., in Milford, Conn. He is responsible for sales planning, staff administration, marketing services and supervision of the 60 Milford field representatives located throughout the United States and Canada. Tom is an acknowledged authority on riveted assembly methods and is the author of numerous articles and papers on rivets and riveting equipment. He is also Vice President of the Orange Land Conservation Trust, Director of the Orange Non-

Profit Housing Corp., a former member of the Milford Representative Town meeting, and former Director of the Milford Chapter, American Field Service. He lives in Orange, Conn., with his wife, Margaret, and their children.

Dr. John F. McCarthy, Jr., a professor of aeronautics and astronautics at M.I.T. and a member of the Air Force Scientific Advisory Board, recently was awarded the Meritorious Civilian Service Award. This award is the highest civilian honor given by Air Force Systems Command. The award was accompanied by a letter of appreciation from former Secretary of the Air Force, Robert Seamans. He is an Associate Fellow of the Royal Aeronautical Society and holds membership in several technical and research organizations. Dr. McCarthy is married to the former Camille Martinez of Los Angeles. They have one child and live in Wellesley Hills, Mass.

A.S.M.E. has published a paper entitled, "Tool Wear and Tool Life", authored by **Nathan H. Cook**, Professor of

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David Grossman has been named Senior Vice President in charge of financial control of Chase Manhattan Bank. Prior to this appointment he served as Budget Director for the Lindsay Administration. He and his wife, Hannah, live in Manhattan with children, Benjamin 15, and Jan 12. . . . **William Plouffe** is President of Charleswater Associates, Inc., a consulting firm in Boston. . . . **Frank Mamrol** has, after 11 years with General Electric Reentry Systems, returned to his favorite interest—helicopters. He heads the Rotor Hub and Upper Controls engineering group for Heavy Lift Helicopter and is busy designing prototype aircraft at Boeing Vertol Co., in Philadelphia. . . . Another switcher is **William R. Hewitt**, who has moved from the chemical industry to electronics and is Accounting Manager, Electrical and Mechanical Products, for Carbon Products Division of Union Carbide in San Jose, Calif.

Fred Scheidler is Design Engineer with Hamilton Standard Division of V.A.C., when he isn't sailing, and then there's **George Arey** who sells sailboats when he isn't working for Storet Webster Engineering Corporation in Newburyport, Mass. . . . **James P. Friend** has moved from New York University to Drexel University in Philadelphia as Professor of Atmospheric Chemistry and is continuing research on stratospheric aerosol formation and related chemistry. . . . **John H. Bergmann** is Director of Engineering for A. Gusmer Inc., Crawford, N.J., engaged in design/sale of brewery, beverage and food processing machinery. Family status "still just wife and two children. Just getting older." . . . **Clifford J. Kronauer**, with family statistics of six children and one grandchild, has retired as Major General of the Air Force and now manages Environmental Systems for General Electric Space Division, Valley Forge Space Center, Pa.

In Ballwin, Mo., **Gordon D. Shaw** is the Business Manager of Covenant Theological Seminary of the Reformed Presbyterian Church. . . . **Francis W. Jacobanis** is Manager of Marine Operations for Atlantic Richfield Co., in Boylan, Pa. . . . In the recent marriage category we find **Robert T. Johnson**, Senior Buyer, Contracts Administration for Southeastern Pennsylvania Transportation in Philadelphia. . . . Another recently married classmate is **Donald F. Reis** who married Terry Foster and is living in Tarrytown, N.Y. . . . **Gordon Zucker** is still making tantalum capacitors, serving as Engineering Manager for Dickson Electronic Corporation in Scottsdale, Ariz. His daughter, Laurel, 18, is a sophomore at New England Conservatory and a flutist; another daughter, Denise, has started at Mt. Holyoke and Charles, 14, is a credible violinist. . . . **Walter O. Davis**, Branch Manager of Warren Brothers Co., in Brockton, Mass., has all three of his children enrolled in college at the Catholic University of America in Washington, D.C. Expensive assign-

ment!

An interesting news item reads: "**Manfred Gans**, Vice President of Scientific Design Co., (N.Y.C.) recently returned from a business trip to Peking. He found China a fascinating country building a society totally different from our own and totally different from Communist Eastern Europe. This is a country which, so far, has pulled itself up by its own shoestrings but now has decided on massive import of western technology, a country actively using its 2½ thousand years of recorded civilization, now experimenting in the most advanced social engineering of 'continuous revolution', a country which has overcome abysmal poverty, famine, epidemics, drug addiction and crime but where incessant propaganda and regimentation is not only regulating all aspects of the work-day but also almost all leisure activities.

"Some Chinese chemical engineers seem to be excellent and all display a lot of enthusiasm and a great desire to learn. Undoubtedly this is a nation 'on the go', a nation where the government still commands the dedicated support of its people."—**Fred W. Weitz**, Secretary, 4800 S. W. 4th St., Des Moines, Ia. 50321; **Samuel Rubinovitz**, Assistant Secretary, 3 Bowser Rd., Lexington, Mass. 02137; **John Dowds**, Assistant Secretary, 1800 N. W. 18th St., Oklahoma City, Ok. 73106; **Marshall Alper**, Assistant Secretary, 1130 Coronet Ave., Pasadena, Calif. 91107

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Dear Guys and Dolls of 1953: Bits and pieces of news have rolled in, but hardly anything "to write home about." . . .

John Morgenstern reports that he is still living in Lexington, has three sons and is mad about hockey. He's still working at MITRE Corporation as Director of Futures Studies; has spent 12 years there in various capacities on many interesting national defense jobs. His wife, Barbara, has been active in Metropolitan Cultural Alliance as theater arts coordinator and producer of performances in '73 and '74. . . . **Ted Bodner** is still an orthopedic surgeon in Hackensack, N.J. He adds, "The time for hobbies grows shorter every week, but I try to keep the tennis and squash going. The kids are 16½ and 15½ now—almost time to send the son off to college! THAT is a funny feeling". . . . Speaking of funny feelings, try and top this. My 14 year old is only 6 feet and 2½ inches tall, and still growing; thus, poor ole Pop has to look up to him (P.S. I sort of enjoy it, though.)

. . . **Marshall Merriam** is Associate Professor of Engineering in the Department of Materials Science, University of California, Berkeley. He's teaching and doing research in solar energy, and seems to be "living the good life." For instance, he noted that he spent the 1971-72 academic year on leave to Technology and Development Institute, East-West Center, Honolulu, and the summer of 1973 on a travel grant to visit India (on behalf of both governments) to lecture on solar energy.

Olgierd Prus writes, "I am seeking an

opportunity to apply technical and management skills in non-defense business systems; digital computers, management, operations research. Hopefully, the position will be in a profit-making business. Any assistance in locating a suitable position will be much appreciated." . . . By the way, just so that everyone will be aware of the wide range of services provided by your diligent and progressive Class Secretary, let me report the following. Recently, I received a note from a male member of another M.I.T. class requesting that I forward the new address of a certain female member of our Class. Needless to say, I was happy to oblige and, of course, to carry out such pleasurable duties in full confidentiality. . . . Old friend **Bill Gouse** apparently was named as Acting Director of the Office of Coal Research in the Department of Interior; the notice did not say whether or not he was stepping down from his post as the Interior Department's Director of Research and Development. [Ed.—Bill, tell us, is that a promotion or a demotion?] Sorry folks, but that is all the news I have.—**Martin Wohl**, Secretary, 1420 Centre Ave. #1706, Pittsburgh, Pa. 15219

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I hope that you've filled out and returned the questionnaire. The 20th Reunion Committee wants to have your opinion of the best choice for the reunion site. Their idea is that we can plan a vacation around the reunion and venture to some romantic spot. I'm game, if my wife will let me go and if there's enough gas in the lawnmower to get me there.

By the time I had gotten the news of **DuWayne Peterson's** position at R.C.A. into the Class Notes last February, he had been promoted to Staff Vice President, Management Information Systems. He is now responsible for assuring the optimum use of computer systems throughout R.C.A. . . . Infrared Industries, Inc., of Waltham, Mass., has elected **Gilbert Davidson** as a vice president. He is also the General Manager of the Thin Film Products Division. Before joining the company in 1972 he was a Vice President of American Science and Engineering. . . . Colonel **James A. Abrahamson** has been nominated to the grade of Brigadier General in the United States Air Force. He is Commander of the 4950th Test Wing of the Aeronautical Systems Division at Wright-Patterson Air Force Base in Ohio. At present he is responsible for flight test programs and a spectrum of research and development services. . . . **Richard Gardner** is now the Deputy Director of the Coastal Zone Management Program of the National Oceanic and Atmospheric Administration of the Department of Commerce. . . . **Marsbed Hablanian** is the Manager of Engineering at the Varian Vacuum Division plant in Lexington, Mass. In 1973 he was elected to the Board of Directors of the American Vacuum Society. He was invited to present a paper on high vacuum technology at the International Vacuum Congress in Kyoto, Japan, during March 1974.

A member of our Class was recently elected to the grade of Fellow of the Institute of Electrical and Electronics Engineers. **Robert D. Cutkowsky** was so honored at the annual banquet during Intercon '74 in New York City. . . . Also in I.E.E.E. news is **Arthur Solomon**, who gave a lecture on commercial applications of microwaves at the I.E.E.E. Boston Section lecture series held at Arthur D. Little, Inc., during February, March, and April of this year.—**Allan C. Schell**, Secretary, 19 Wedgemere Ave., Winchester, Mass. 01890

A Solid Waste Reactor To Run the Boston Subways?

John M. Rufo, '54, President of Boston Power Associates, wants to run all the subways and trolleys of the Massachusetts Bay Transit Authority (the Greater Boston area) on power generated by burning solid waste. He thinks he could supply steam to electric generators at a cost as low as 75 cents per 1,000 lbs.—which compares with \$2.40 which the M.B.T.A. now spends with "energy crisis" fuel prices. Mr. Rufo proposes to be paid \$6 a ton for disposing of household waste, perhaps \$10 a ton for commercial scrap.

The process is pyrolysis—chemical decomposition brought about by the action of heat. The "reactor" which Mr. Rufo has developed with a Detroit-based engineer, B. Richard Ankersen, runs with minimum oxygen, and waste is consumed with almost no flame at temperatures up to 2,200°F. Burning is complete. "Everything we have is usable," he insists; "we get the last bit of energy conversion out of it." The residue from typical municipal trash is a small collection of lumps of once-molten glass or metal; presorting is unnecessary.

Jack B. Howard, Associate Professor of Chemical Engineering at M.I.T. who has been a consultant to the firm, is quoted as thinking that Boston Power Associates' process is unique because it combines clean burning with the ability to handle "almost any kind of refuse, and produce steam."

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Gordon Bell was elected a Fellow of the I.E.E.E. for contributions in the design of time-sharing computer systems. . . . **Jewell Bowen** has been named Associate Vice Chancellor of the University of Wisconsin. . . . **Fred Jelinek** was elected a Fellow of the I.E.E.E. for contributions to the theory of information transmission. . . . **Dimitri Manthos** writes that he is now living in England but still working on shipping operations—legal and financial planning. **John Patierno** completed the A.M.P. at Harvard Business School last fall and returned to Northrop as Manager of the F17 program development. . . . **Bob Santos** has moved to New York to be Director, Data Systems Planning and Support for A.T. and T. . . . **Ed Zoolalian** writes that he is still Manufacturing Manager at Neff Instrument where business is booming. Also

Denise has started a part-time business. In his spare time Ed is running for Republican Control Committeeman for his California district. With all that, no wonder he has slimmed down to his senior class weight. . . . **Bill Grinker** is accepting volunteers for planning the 20th Reunion, just two years away. Contact Bill at American Used Computer's new address: 712 Beacon St., Boston 02215. By the way, did you see the large article on the used computer business on the back page of the February 7 *Wall Street Journal* which liberally quoted Bill.

A note of sadness for those of us who lived in the dorms—Sam Mason, the Master at Baker, died last spring. Co-secretaries: **Bruce B. Bredehoft**, 3 Knollwood Dr., Dover, 02030; **Mrs. Lloyd Gilson**, 35 Partridge Rd., Lexington, Mass. 02173

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An envelope arrived last week that apparently got lost somewhere in the Caribbean. The items inside were very old. For example, **John Spencer** wrote us in January, 1973 as follows: "Am enjoying my friendships with fellow alumni in both northern New Jersey (where I am Treasurer of the M.I.T. Club) and in New York City (where I am Membership Chairman of the Alumni Center). In the past 12 years I have worked in three local Boy Scout councils, Middletown, N.Y., Dover, N.J., and now in New York City where I am a member of the finance staff raising this year's budget of 2½ million dollars." . . . **Bob Sterrett** has been appointed by Eastman Kodak as Assistant Director of the Project Development Division in the Kodak Park Division. He was formerly supervisor, black-and-white emulsion product control in the paper sensitizing division of the paper manufacturing organization at Kodak Park. A news release provided the following information: Bob joined Kodak in 1957 as a development engineer in the paper service division. In 1959 he transferred to the paper sensitizing division and held increasingly responsible positions over the next several years including section head, color development group, color product engineer, supervisor, development, and supervisor, emulsion control. In January, 1973 he assumed his present responsibility in the project development division. In addition to his B.S. from M.I.T., Bob holds an M.S. degree in optics from the University of Rochester. He is a member of the Society of Photographic Scientists and Engineers.

And from late 1972 the news that Allen Burgess joined Raytheon Co., as Manager of the Computer Systems Laboratory in the company's Equipment Division. Previously Allen was with Honeywell Information Systems Inc., where he had been Group Director for Computer Systems. He has held a series of responsible engineering and engineering management positions with Honeywell, Beta Instruments, and Adage, Inc. Allen has a master's degree in business administration from Boston University. He is a member of the Institute of Electrical and Electronics Engineers. He and his

family reside in West Newton, Mass. . . . **Ben Edwards** is now Chief Chemist for Old-North Manufacturing Co., Inc., in Lenoir, N.C. The company is a supplier of concrete curing agents and finishes throughout the South. . . . **Paul Nicholson** joined G.T.E. Sylvania in Needham to manage communications programs. He writes that he travels frequently to Washington. He and his wife, Virginia, are still going strong in antique dealing. With his son Peter, he is walking stretches of Appalachian Trail. . . . **Vernon Porter** is now Superintendent at C.F. and I. Steel Corp., Pueblo Plant. Vernon joined C.F. and I. in 1957 in the Industrial Engineering Department and became a practice engineer in rolling and finishing in 1962. He was appointed Assistant Superintendent, Rolling and Finishing Mills, South in 1968, the position he held at the time of his recent promotion. Vernon is married and has two children. . . . **Ralph Warburton** writes that he has inaugurated a new graduate program in urban and regional planning at the University of Miami. He has been appointed Chairman of New Neighborhoods Action Committee, Greater Miami Chamber of Commerce. . . . **Gerson Meyers** is now a partner in Dressler, Goldsmith, Clement and Gordon, Ltd., practicing patent law. The Meyers have three children, two boys and a girl, and have been living in Northbrook, Ill.

Paul Carr had the honor of presenting the Guenter Loeser Memorial Lecture at the Air Force Cambridge Research Laboratories in October. Paul's lecture was entitled "Microwave Acoustics: Research to Applications." The Guenter Loeser Award is one of three major awards given annually at Air Force Cambridge Research Laboratories. . . . Finally, a nice letter from **Ron Keefe** which reads as follows: "Hi. I was surprised to see my name in print in the March/April *Tech Review*. However, I do have to admit that it is an interesting way to prod a non-writer into picking up the dictating machine to say hello.

"For the locals—I've seen **Dick Baird** after his trip—he survived in great shape. . . . **Hugo Liepmann, Esq.**, is now a partner at Kenway and Jenney, eminent patent and trademark counsel in Boston. **Alexander (Sandy) Bernhard, Esq.**, is established with Hale and Dorr here in Boston. . . . **Gary Dischel's** company now is managing the beautiful Grotto Bay Beach Hotel and Tennis Club in Bermuda—maybe we will get a reunion offshore one of these days.

"I'm afraid that Pat and I stopped at 3, so I do wonder whose "four Mongolian Kangaroo Rats are doing fine." Ron, Jr. is 15, Chris is 14, and Maribeth is 8. They do grow up fast. Nothing too exciting here in Boston. The family spent our children's February vacation in Barbados—beautiful island and very British. Trying to help the boys out in their math courses has convinced me that I'll never be a computer whiz, besides my old slide rule has frozen from disuse. I wonder who's at B.U. and the Children's Zoo. I think I'll keep my hand in at the law.

"The next time I make it to Puerto Rico, I'll make it a point to call you. I

understand from friends that extended stays in the Caribbean sun (I suppose that can include Puerto Rico) do things to a person—after reading your column, I think you deserve a checkout."

Ron seems to agree with my employer, Mobil Oil Corp. Effective in the middle of the summer I will be getting checked out in a new job in our corporate headquarters in New York. I'll be Manager of Crude Supply Planning and Special Projects in our Middle East, Transportation and Supply Department. It should be a fascinating job. Betty and I and the children are looking forward to living in New York. I have been out of the country now for eight years; Betty has never lived in the United States. We are buying a co-op apartment on Riverside Drive; our new address is given below. We look forward to seeing more of our classmates in our new location. After we've settled in we will see if we can get some of the New York crowd together for a few drinks.—**Fred L. Morefield**, Secretary, Apartment 6-A, 285 Riverside Drive, New York, 10025, N.Y.

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Bob Clark notified me that he recently attended the M.I.T. Management Seminar "Challenges to Contemporary Management" held in Washington, D.C. "This was an excellent presentation and the Sloan School of Management deserves a great deal of credit—this sort of thing also sparks alumni interest". . . . **Mitchell Dittmann** is currently teaching at Texas Southern University at Houston on a special assignment for his employer, the I.B.M. Corp.

A cryptic back-of-envelope note from **Elliot Fineman** repeated here in its entirety, "Life is fun—sometimes."—**Art Collias**, Secretary, 61 Highland Rd. Brookline, Mass. 02146

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A quiet month on the news front. I notice a general reduction in the mail these days but do not understand the reason. Since the bulk of my material comes with contributions to the 'Tute, I assume that these have also sluffed off. Your activities are of interest to your classmates. Even if they do not remember you personally they are interested in the progress of their contemporaries.

Bill Grimmell wrote to say that 1973 had been a good year. He writes that "I received my first patents (one for a color analyzer and the second for a high speed pharmaceutical dose form counter), and I also received a second child, Cathy, in March. I am now a group leader in the applied science department of Hoffman LaRoche." . . . **Chris Lange** started '74 right, giving a paper on D.N.A. structure at a meeting on D.N.A. repair in Squaw Valley, Calif. He says that he really enjoyed the meetings since he is a fine skier having finished just out of the money in a ski race in Banff last year. Chris is doing research and teaching at the University of Rochester. . . . Nine-teen Seventy Three was also a good year

for **Arrigo Mongini** since he received a superior achievement award from the U.S. Department of Transportation in connection with work which led to provisions in the highway act of 1973 making highway trust fund moneys available for public transit. Those of us living in urban areas are also grateful to Arrigo.

J. P. O'Connell writes that he has been doing alot of visiting recently. He is on leave from the University of Florida's Department of Chemical Engineering. Last spring he was Visiting Professor in the Energy and Kinetics Department at U.C.L.A.; last summer he was Visiting Professor in the chemical engineering department at Cal. Tech, and since the fall he has been Visiting Professor in the chemical engineering department at Stanford. There seems to be a northward trend to his visits. Perhaps next year he will be in Oregon where he can visit **Ken Singer** who is in group practice (of medicine) in Eugene. Ken says that he has Governor McCall's request that he not extoll Oregon's virtues. Lieutenant Commander **Millard Firebaugh** is also out on the west coast. He is in San Diego, Calif., working with the submarine development group "ONE", and is working on the deep submergence rescue vehicle (D.S.R.V.) and the bathescape Trieste. The Firebaugh's had a daughter named Samara Louise [lovely name, isn't it?] born last November.

Further west, in Taipei is **Ed Tucker** who writes, "I am participating in a plant design effort. Previously I spent a year in Tokyo on a similar assignment. I'm still with Hercules, Inc. I plan to be in Houston in mid-year preparing for a major plant start up there". . . . Meanwhile, back here in God's country, **Frank Lane** writes, "We (wife, Jean, and two sons, ages 1 and 3) returned to the east coast in the summer of '73, and I joined the U.S. E.P.A.'s Office of Planning and Evaluation. I'm enjoying D.C., and am looking forward to the sailing and tennis in the spring. I do miss the climate and scenic beauty of our previous home south of Los Angeles."

Well, Frank, soon you will learn to love not knowing what the weather will be in two hours as do all true easterners.—**Andrew G. Braun**, Secretary, 464 Heath St., Chestnut Hill, Mass. 02167

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Major **George W. Meyer** is returning to Travis Air Force Base, California where he will receive two years of subspecialty training in Gastroenterology. . . . Dr. **T. P. Labuza** has been appointed National Program Chairman of the Institute of Food Technology, and will spend a quarter leave as Visiting Professor at the University Montpellier, France, as I.F.T. Scientific Lecturer. He also had a book published March 1, 1974, *Food for Thought*. . . . **Bill Anderson** is an instructor in psychiatry at Harvard Medical School and is on the staff of Massachusetts General Hospital. . . . **Anthony Mack** is presently employed as Manager of Product Development, Sweetheart Plastics, and spends his "leisure" time with Cub Scouting, P.T.A., Little League, etc.

He and his wife, Dolores, have three children. Tony is Chairman of the North Reading Conservation Commission and his wife is Vice President of the North Reading League of Women Voters.—**Gerald L. Katell**, Secretary, 7 Silverbit Lane, Rolling Hills Estates, Calif. 90274

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April 1974. Inadvertently missed a deadline last month, so you will have a double dose of one-liners this issue. Actually I did have a couple of letters in the last few months—notes from **Dave Johnson**, **Gene Sprouse**, and a description of M.I.T. in winter from **Georgie** and **Jim Hallock**.

Dave Johnson's letter came all the way from London—most of my letters seem to be coming from outside the U.S. Since leaving the Institute, Dave's travels have taken him back and forth across the Atlantic three times already—an army tour in Germany, an engineering stint with Westinghouse in Muncie, Ind., and more engineering with Aladdin in Nashville, Tenn. Last summer when some of us were heading for New England and Martha's Vineyard, Dave was moving back to Europe to head the international operations of Temp-rite, a subsidiary of Aladdin. Temp-rite supplies "meal distribution systems"—compartmentalized trays with disposable dishes serving food for airlines, hospitals, and health care institutions. "My present responsibilities are the most challenging and exciting I have ever had," writes Dave—setting up the machinery for an international marketing and production operation all over Europe. Dave and Lyla, along with two sons and a daughter, are living in Chalfont St., Giles, a small village about 25 miles west of London, and would like to hear from old friends who might be in England.

Al Ramo has been a frequent visitor at the Johnsons', wherever they have lived. (England too?) Al is living in Dallas, playing with computers and geophysics for Sun Oil Company and somehow is still single. . . . Dave also hears frequently from **Harley Jordan** who is with Burroughs in Detroit and is living on a veritable farm with his wife and four daughters. Dave also keeps in contact with **Louis Williams**, **Jay Latimer**, **Keith Vail** and **Woody Bowman**. Some data from the old news file reveals that Woody is now an Assistant Professor of Economics at the University of Illinois at Chicago.

I received a Christmas card from Japan from H'y and **Gene Sprouse**. The Sprouses are having a great time in Tokyo. Soh Steven goes to an international school, daughter Emi to a Japanese kindergarten. Gene does physics on two cyclotrons, one within walking distance of his apartment. As of December the energy crisis had not had much effect on life in Tokyo, but people were bracing for shortages in 1974.

Between the deadline I missed and the normally long lead times for *Tech Review* columns, this next letter is going to sound a little strange. But if it is warm where you are now perhaps a description of M.I.T. in winter may cool you

off. From Georgie and **Jim Hallock**: (postmarked December, 1973), "Christmas has worn off everywhere but M.I.T.. The infirmary has two wreaths on the door and a huge welcome mat out front. Perhaps this is a comment on the quality of New England weather conditions or just life at Tech.

"We finally got some snow and the old Cambridge scene is much improved. There has been some complaining but there was a huge Snoopy in front of Westgate.

"The old candy factory on Ames St. is gone. There is a lot of refurbishing going on there. Before the student union was built it was the only place to get an ice cream cone. In later years they sold candy seconds. Now only NECCO is left.

"Amazing news is on the way. As every student knows, the beneficial rays of the Cain's sign flow down upon the athletic field. After all, what's the sense of having an urban campus if you don't have a sign going for you? Well, the energy crisis has hit the Coca Cola sign on Storrow Drive and the Citgo sign in Kenmore Square, but the Cain's sign is the only one we mourn."

I'm sure many of us will have fond memories of the Cain's Mayonnalse sign—but whatever happened to Victor Coffee—Victor Tea?

The Hallocks had a recent visit from **Donald Knutson** and his wife. Don is at Fordham, having moved from Columbia, and is working on his third book. . . . **Roger Pyle** and his wife are both working at the University of Chicago. A note in the old news file confirms this and adds that Roger is working with Pioneer-10 spacecraft data.

My own travels recently took me to Cincinnati where I dropped in on **Dick Males**. Dick is involved in several new ventures these days, including a new company and a new family. Dick, wife Barbara, and son Matthew are living in a big old house with a large dog named Apple and at least two cats. On the night I visited, Dick and Barbara were ordering seeds for spring planting at their cabin in Morrow, Ohio, on the Little Miami River. As always, Dick is busy with a great variety of activities including archery (he has a target shooting range in his basement), photography (a basement darkroom), and horticulture (the house is covered with plants.) Dick also recently produced a TV documentary, an outgrowth of a study he did on the James River region in Virginia. The new business venture is W. E. Gates and Associates (Dick is an associate) which specializes in social and behavioral studies in environmental management. Like so many of our classmates Dick is getting a taste of entrepreneurship. Good luck on the new ventures.

A recent note and earlier letter gave a capsule history of **Ray Soifer's** activities since leaving M.I.T. After graduating in Course VI, Ray promptly abandoned engineering and moved up the street to the Harvard Business School. A four year stint at Harvard included an M.B.A. (1965) and Ford Fellowship work on business-government relations. During the 1966-70 period Ray acquired a family (wife Arlene, and son Donald Franklin,

born 1968) and worked with John Diebold and Hayden Stone in financial management positions. In 1970 Ray went to Washington as a special assistant for finance in the Department of Commerce, charged with revitalizing the lagging U.S. Merchant Marine. His efforts resulted in the Federal Ship Financing Act of 1972, revisions of the I.R.S. code creating better conditions for ship leasing, and \$2 billion of contracts for new ship construction. About a year ago Ray moved back to New York as Vice President of Banker's Trust Co., with responsibilities for financing shipping and transportation ventures. "Not much to do with Course VI," writes Ray, "But it's interesting and significant work. These days my sole tie to electrical engineering is through ham radio; I am a director of A.M.S.A.T., the Radio Amateur Satellite Corp., which builds and operates communications satellites for the amateur service. I am also interested in M.I.T. affairs as a member of the Educational Council."

After many years in Pittsburgh with Gulf Oil, **Marvin Singer** has accepted an appointment in the Executive Office of the President on the Council on Environmental Quality. "Washington is really an exciting place to work—sure beats Pittsburgh! My energies are now being expended working on energy programs." Marvin and Karen are living in Reston, Va.,—ironically that makes Gulf Oil Marvin's landlord. As this appears Marvin's son Jonathan will be one year old, and getting a mouthful of teeth.

One liners:

L. H. Pitts writes that he will be finishing his neurosurgery residency in July '75 and will then have to go to work. Don't fret—it happens to the best of us. . . . **Robert Strong** has retired to the "wilds of Pennsylvania", but still consults for his former employer in Latin America. He travelled to Barbados in December and Central America last January.

A note from **John Cheney** reveals that John is a partner in the architectural firm of Erickson-Cheney-Bradt in Mount Vernon, Washington. He and wife, Louise, (Washington State, '62) have three boys aged 8, 7, and 1. . . . **Floyd Stecker** is still with the theoretical studies branch of the Goddard Space Flight Center in Greenbelt, Md. Floyd recently received the N.A.S.A. Medal for exceptional scientific achievement for his theoretical matter-anti-matter cosmology and galaxy formation theory.

Stephen McClure is a staff engineer with Honeywell Information Systems working in the area of design automation. . . . **Frank Cocks** is an Associate Professor of Mechanical Engineering at Duke University in Durham, N.C. . . . **John Lynch**, wife Mary, son Stephen, 4, and daughter Rebecca, 2, live in Newton, Mass. John works at Lincoln Labs. . . . **John Brach** writes that he and his family have moved to Atlanta. John is directing design for M.A.R.T.A. (Transit Authority), doing the first five miles of rapid transit in Atlanta. The Brachs have just moved into a house in Dunwoody, Ga., and report that they like Atlanta very much. . . . Another classmate in Georgia is **Robert Mason**. Robert received his Ph.D. in in-

dustrial and system engineering from Georgia Tech in August, 1973 with a dissertation on organizational strategic planning. With G. William Spann he has formed Metrics, Inc., an engineering and management consulting firm. The beginning has been slow, but hopes are high.

Press Releases:

David Shawaker has been appointed Associate Budget Officer at U.S.C. after spending two years as Associate Budget Director and Assistant to the Vice Chancellor at the University of Massachusetts. . . . **Robert Warman** has been promoted to Assistant Vice President of the Bond Department of the First National Bank of Chicago. . . . **Roger H. Weissinger** is working on a Ph.D. in marketing at Stanford.—**Mike Bertin**, Secretary, 18022 Gillman, Irvine, Calif. 92664

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Robert Bachrach is with the Xerox Palo Alto Research Center after four and one half years at Bell Labs. His wife Virginia is a pediatrician, and they have their own one year old daughter. . . . **Thomas Cerny** has been promoted to Financial Vice President of the Communications Services Group of Arcata National Corporation in Menlo Park, Calif. Tom and his wife Judith live in Sunnyvale. . . . **Bruce Crocker** has recently joined McKinsey and Co., in San Francisco as a management consultant. Bruce, his wife, and their two children live in Palo Alto. . . . **Michael Hirsch** has spent the last 14 months travelling through Asia.

Bruce Hopkins has been elected a vice president of Hamilton Allied Corp., an Ohio based metal casting organization. Bruce joined Hamilton in 1971 after graduating first in his class from Dartmouth's Business School. . . . **Mark Lappin** is practicing law with Kenway and Jenney in Boston. He and his wife Joan are kept busy raising their son Jeffrey, born on January 1, 1974. . . . **Clint Sprott** is an Assistant Professor of Physics at the University of Wisconsin. Clint spent a couple of years at Oak Ridge in the Thermonuclear Division with another of our classmates, **Jim Rome**. . . . **Jerry Weiner**, his wife Sylvia, and their daughter visited with **Gary Walpert** and his family in New Jersey earlier this year. Gary's wife, Ellen and Sylvia were classmates at Boston University. . . . **A. L. Zobrist** will be an Associate Professor of Computer Science at the University of Arizona starting this fall.—**Ron Gilman**, Secretary, 6560 Black Thorne Cove, Memphis, Tenn. 38138

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Not much news this month—hopefully this summer will give you all time to write. I received an interesting letter from a member of another class who notes that the majority of us will turn 30 this year. He enclosed a copy of an article that appeared in *New York Magazine* this past winter which dealt with the subject. A number of us found it particularly interesting so I will send a copy of it to

anyone who writes to me directly with some news. And now the news—**Tim Connelly** writes, "The medical electronic company, Filac Corp., that I helped start two years ago, has become profitable. Our main product monitors pulse rate and temperature of non-critically ill patients. . . . **Fred Gruhl** and his wife, Mary, were here last week from Michigan (General Motors) to see us." . . . **Michael Fletcher** is currently Assistant to the Director of Manufacturing Planning, Machinery Group Headquarters of F.M.C. in Chicago. His wife Diana is an M.B.A. candidate at the University of Chicago. . . . From **Matt Fichtenbaum**, "I am still living in the countryside in Chelmsford, still working with General Radio as a computer wizard, and looking forward to a month on vacation in Scandinavia this summer. I also have the so-called distinction of having commuted to work by bicycle before it became necessary. I am contemplating leaving electronics to start a mail-order gasoline business."

Peter Addis is currently working at Harvard Observatory for a consulting firm as a programmer. He is pursuing a master's degree in computer science at Boston University and writes that he is "taking a karate course, one gerbil has died, but three survivors are doing fine." See, I told you the news was scarce this month. However, it gets better. . . . **Michael Ward** is now at Hewlett-Packard designing instrumentation for laser interferometer systems and **Allen Post** has just completed his evening M.B.A. program at Boston University while working at MITRE. To those of you who wrote this time I send my thanks and encourage the rest to take advantage of my special offer by sending some news before the end of the summer.—**Tom Jones**, Secretary, 59 Commercial Wharf #6, Boston, Mass. 02110

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We have received a note from **Gene Sartin** who is working for I.B.M. in Poughkeepsie. In his spare time he has continued fencing, taken up racing formula S cars for a hobby, and has received a pilot's license. He is now building a formula one racing plane, possibly for competition. He was married in August 1972, and as he describes it, "so now I'm doing typical homeowning chores, as you can imagine." . . . **Tom Murphy** wrote to tell of the birth of his son, Christian, last August 14. Tom adds, "I'm a little worried, he can't use a sliderule yet."

On a sadder note, we have heard of the death of **Julie Stanley** last August, but do not know any of the details. Our sincere condolences to her family and friends.—**Gail and Mike Marcus**, 2207 Reddfield Dr., Falls Church, Va. 22043

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The mail bag this month was almost empty so please write and let me know what you or other members of our Class are doing. Otherwise, our friend the blue dwarf might come out of retirement to

shake his finger at our unresponsive classmates.

Among the letters I have received, **John B. Black** writes that he is finishing the last year of a four-year army commitment as a programmer on the faculty at the army's Command and General Staff College in Fort Leavenworth, Kansas. He is creating an interactive software system for a division tactical operations center and creating a computer assisted instruction course to teach people how to use the system. In September John will leave the army and commence work on a Ph.D. in psychology at Stanford University as the recipient of a full fellowship. Among his tasks at Stanford, he will be working on mathematical and computer simulation models of human learning and memory while developing methods and techniques which will use these models to create an optimal computer assisted instruction system. His wife, Rita, (Smith, 1971) is working as the Program Director of the Leavenworth Center for the Handicapped. In September she will enter a master's program in social work at the University of California at Berkeley. . . . **Tom Najarian** and his wife, Sina, are living in Belmont, Mass., and welcome any visitors from our Class. Their children, Nova and Mark, are now two and one half years and 7 months old, respectively. Tom will be graduating from Harvard Medical School this June and will then commence his medical internship at the Boston Veteran Administration Hospital. Sina is teaching at Buckingham, Browne and Nichole School in Cambridge. . . . **Roosbeh Chubak** has been named Advertising Media Manager for Merck Sharp and Dohme, a division of Merck and Co., Inc., in West Point, Pa. Roosbeh previously received his M.B.A. from the University of California at Berkeley and is married to Marianne Gerson.

Steve Zayac and **Marilyn Tamm** were married on March 13, 1971. Since then, Marilyn worked for Owens-Illinois and then for Oldsmobile until that facility closed. Steve finished his work towards his Ph.D. at Michigan State University and is now working for Induction Process Equipment Corp., in Madison Heights, Mich. They recently bought a house in Rochester, Mich., and Marilyn hopes to find work nearby. . . . Captain **Roger Chang** is presently stationed in Shemya, Alaska. He is looking forward to "joining civilization again one of these days. And then once more to sunny Arizona and another outpost. That's army life." . . . **Max Tabak** is doing thesis research towards a Ph.D. in experimental elementary particle physics at the University of California at Berkeley. He has also started learning how to paint and would like to hear "from any of the denizens of old Connor one." . . . Hope you have a fun summer!—**Richard J. Moen**, Secretary-Treasurer, W-1781 First National Bank Building, St. Paul, Minn. 55101

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This column will be on the brief side this month. The mailbag is rather thin, and your Secretary, about to take off for a

couple of weeks in Hawaii, is suffering from a case of pre-vacation inability to work. Some of our classmates, on the other hand, are apparently quite industrious. **Ernest Gladney** is co-author of an article entitled "Atmospheric Concentrations and Sources of Truce Metals at the South Pole," which appeared in the January 18, 1974, issue of *Science*. He was married in June, 1972 to June Allen (B.S. 1973, elementary education, University of Maryland). Hopefully, Ernest will finish a Ph.D. in environmental chemistry this summer and then head out to New Mexico and the mountains he loves. . . . Kathi and **Oscar D. Asbell, Jr.**, (who forgot to mention where they are living), have just completed a new kitchen and bath for their 65-year-old house. Oscar is doing structural analysis for Kollmorgen, and Kathi is chief dietician at Franklin County Public Hospital. . . . **Jim Pelegano** is now a second-year medical student at the University of Pennsylvania. He and his wife will return to Connecticut this summer for three and a half months while Jim works as an intern in a local hospital. . . . **Steve Cooper**, who is interning in ob-gyn. at Los Angeles County-U.S.C. Medical Center, sends us news of other classmates who are also doing internships. . . . **Dave Koh** and **Chris Rose** are interning in medicine at Beth Israel Hospital in Boston. . . . Also interning in medicine are **Tim Russell** at the University of Virginia Hospitals in Charlottesville and **Tom Najarian** (S.M.'70) at the Boston V.A. Hospital. . . . **Jason Zielonka** and **Warren Adams** (Ph.D.'70) are interning in surgery at the University of Minnesota, Minneapolis, and the University of Michigan, Ann Arbor, respectively.

Michael Kearns married his college sweetheart, Connie Zelin, in August 1972. Michael is in his second year at the University of California at Davis, working toward a Ph.D. in English. His areas of concentration are theories of fiction and 19th century British literature. This is also Michael's second year of teaching freshman English. . . . **Linda Lippitt Furrow** and her husband Edward Furrow '71 have moved to Calgary, Alberta, where they are the proud owners of a new home with a lovely view of the Canadian Rockies. Linda is working as a programmer with Pan Canadian Petroleum, participating in the change-over from a service bureau to an in-house computer. The Furrows took off last summer and spent two months travelling across Canada with a tent trailer. They had a great time and saw lots of beautiful country. . . . **Bill Kindel** has been the proud father of a son, Bobby, since May, 1973. . . . Shortly after graduation, **Michael W. Hurst** married Patricia Scully (B.U.'71) of New Jersey. He worked for a clinical psychologist for a year, and enrolled at Boston University in counselling, receiving his M.Ed. in College and Adult Counselling in December, 1971. He was granted a teaching fellowship and then completed an Ed.D. in counselling psychology in September, 1973. Michael has been working as a research psychologist in psychosomatic medicine at the B.U. School of Medicine since July 1973, and has been "really" enjoying himself.

Jim Bronfenbrenner writes that after

graduating in 1971 with an M.S. in chemical engineering, he "kicked around" for six months and spent some time leading canoe trips in the Adirondacks. He is now working in petroleum refining, and looking forward to returning to school to study energy economics. . . . **Mary Thornton** has left the Associated Press, where she was doing political and investigative reporting, to join a new news team at the *Boston Globe* doing features, investigations, and trend stories in the suburbs. . . . **Jim Griffiths** is working in the Naval Reactors group in Washington and is about to start training in Pittsburgh. . . . **Mike Safonov**, completing his time with the military, is serving as Electronics Division Officer aboard the aircraft carrier U.S.S. *Franklin D. Roosevelt*. Mike is due to return to "comclivant" in May, 1975. . . . **Joel A. Mosher** is back at the Jet Propulsion Laboratory in Pasadena, Ca., doing image processing work on Mariner 10.

Since November, 1973, **Bill Copeley** has been working for the New Hampshire Historical Society in Concord as a technical assistant. . . . **Dave Sheldon** is working for Eastern Gas and Fuel Associates in Boston as a Programmer/Analyst. Before joining Eastern, Dave was a programmer for Fay, Spofford and Thorndike, Inc., a Boston programming firm. . . . Shortly after receiving his M.S.I.A. from Carnegie-Mellon University in May, 1972, **Richard Nagy** entered active duty with the U.S. Air Force and was stationed as a Computer Operations Officer inside Cheyenne Mountain (NORAD Combat Center). In February of this year, he changed jobs and became programmer for NORAD, remaining in Colorado Springs. Richard says the area is beautiful, the skiing is great, and his job is getting more interesting.

Assistant Secretary, Robert Vegeler writes, "**Carl Yankowski** wrote me a nice letter revealing much class news. Carl, after extensive sales training, will be promoted from marketing consulting in the Pringles division at Proctor and Gamble to marketing as an Assistant Branch Manager. Sandy is finishing her pediatric's clerkship in medical school. . . . **Wayne Wenger** and Carl bumped into each other in the Minneapolis airport while playing pinball. Wayne is finishing his M.B.A. at Chicago and is looking for a job in retailing or finance. . . . **Terry Michael** and **Bonnie Paulsen** Michael are still in Manhattan where Terry works as a corporate staff analyst for I.T.T. . . . **Neil Ross** is a junior medical student at Northwestern and is specializing toward eye surgery. **George Allen** has invested in a home in the Boston area. He is working on a Ph.D. in nuclear engineering and is associated with the nuclear reactor facility at M.I.T. . . . **Sandy Harlow** is also working at Proctor and Gamble as a systems analyst in sales and his wife, Marilyn, is a researcher with the Cincinnati police department. Sandy evidently spent much of his spare time building a Heathkit color TV. . . . **Carol** and **Steve Milligan** are studying marine biology at the University of Rhode Island. . . . **Bill Behrens** is finishing his Ph.D. in the Sloan School and has purchased a house in Cambridge with Earl Tyler. . . . **Ernie Nall**

is managing an apartment complex with his wife, Judy, in Texas. Terry "Snake" Simpson is finishing up his second degree and will be entering the job market.

An interesting old house was bought by **John Light** (III) and family which includes a new baby boy, John Light (IV). John is working for his father in the landscaping business. . . . **John Holding** is finishing his M.B.A. at Chicago also and working on the side by consulting. . . . I am law clerking for an Indianapolis law firm this summer and specializing in litigation. During the school year I was able to clerk for a state court judge and work on the law journal. Had a chance to do a little travelling during the winter by going on a trip to Mexico."

Unclassified Department. Tom Hafer, "70s' only draftee", is no more: he got out last summer on the day before his first anniversary. Tom and his wife took two months off and explored the U.S. by car, with side jaunts to Mexico and Canada. . . . **Robert McKinley** and his wife Carol, currently in Hawaii, plan to return to the Boston area following his separation from the Navy in March or April of 1974. Bob is still playing tennis, and last August won the all-Navy singles title. Bob hasn't seen snow in three years! . . . After working for two years as a research engineer in Cambridge, **Bob Kattel** decided that working with young children was better. He received a master's in Education from Tufts last June and is presently teaching second grade in Weston, Mass. "Seven year olds are fantastic!". . . . **Bill Copeley** has been a "technical assistant" for the New Hampshire Historical Society since November 1973. . . . **Louis Zarfes** is still working at the Patent Office, and doing set design, art work, and acting for a local theater group. He is also engaging in "a little cross-registration with a local Wellesley grad". Louis is looking for any bridge players in the area (some place in Virginia). . . . After spending three years in Palo Alto, **Howard Hoffman** is now living in Manhattan. His wife Janet, who graduated from Stanford with a B.A. in political science, found a limited market for her degree, and is now a stewardess of the "Friendly Skies". Any old friends in New York City can get in touch with Howard through Metcalf & Eddy, his employer. (If you'd like his 'phone number, please contact your class secretary.). . . . **Karen Wattel Arenson** writes that she has finally become a practicing journalist. She is working as a reporter for *Business Week* magazine in their four-person mid-west bureau, covering everything from real estate to worker alienation. So far, she has interviewed Cost of Living Council Director John Dunlop and questioned Melvin Laird, among others. **Greg** is continuing his law studies at the University of Chicago.

That's all for now. Happy Spring!—**Laura Malin**, Secretary, 82 Munroe St., Apt., 1C, Somerville, Mass. 02143

ceived a Cecil Fraser Fund Scholarship. . . . **Becky Donellan** writes that she will be in San Francisco this summer working for Lillick McHose, Wheat, Adams, and Charles (quite a mouthful, huh?) doing shipping law. . . . **David Davis** completed his M.S. in biomedical engineering at Stanford and is "presently enjoying the challenge and excitement of learning to fly at Air Force Undergraduate Pilot Training, Williams A.F.B., Arizona." . . . **Pat Hecht** reports that, "Jim, '70, and I are now living in Denver. We love Colorado and have done extensive hiking and cross-country skiing. I've been working at the C.U. Medical Center in pharmacology. I plan to attend C.U. in Boulder in pursuance of a Ph.D. in music in the fall."

Bonny Kellerman is completing her master's program in social work at the University of Chicago. "Then, after 19 years of school, I'll finally go out into the real world and find a job (I hope). . . . I enjoyed hearing from **Gary Stahl** who writes, "I stayed at M.I.T. last year to compliment my electrical engineering degree with one in biology, and complete the other pre-medical requirements. After a long, trying wait (I didn't get in anywhere until June) I was accepted by the medical school of the University of Rochester for the Class of 1977. Compared to the years of engineering at M.I.T., medical school is easier conceptually but still eats time up like it was going out of style. There's also much less pressure and it's not very competitive—which adds up to a good academic environment. The other major event to report is my marriage last July to Miss Deborah Levy (S.U.N.Y. at Albany, '72) of Fresh Meadows, N.Y. We're very happy and she has a great job as an administrative assistant to the controller of an oil company here. . . . **David Sales** is an M.D.-Ph.D. student at the University of Chicago. His wife, the former Charlene Kantor (University of Illinois, '73) is a first year law student at Northwestern. We visited them last week and had a great time."

Thus ends the second year out in the epic tale of the Class of '72. Now is your great opportunity to get in on the very beginning of year three. Merely take pen in hand and write to:—**Dick Fletcher**, Secretary, 135 West St., Braintree, Mass. 02184

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Getting right down to business this month, **Ken Wayne** is up at the Harvard Business School where he has just re-

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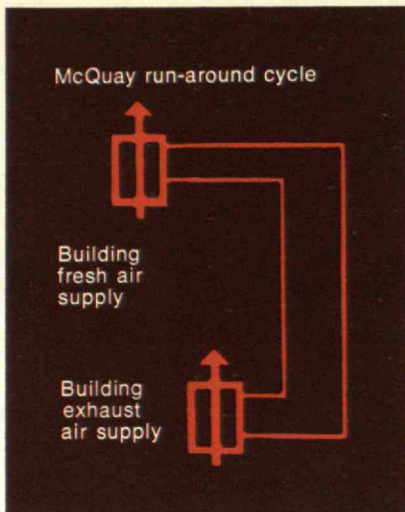


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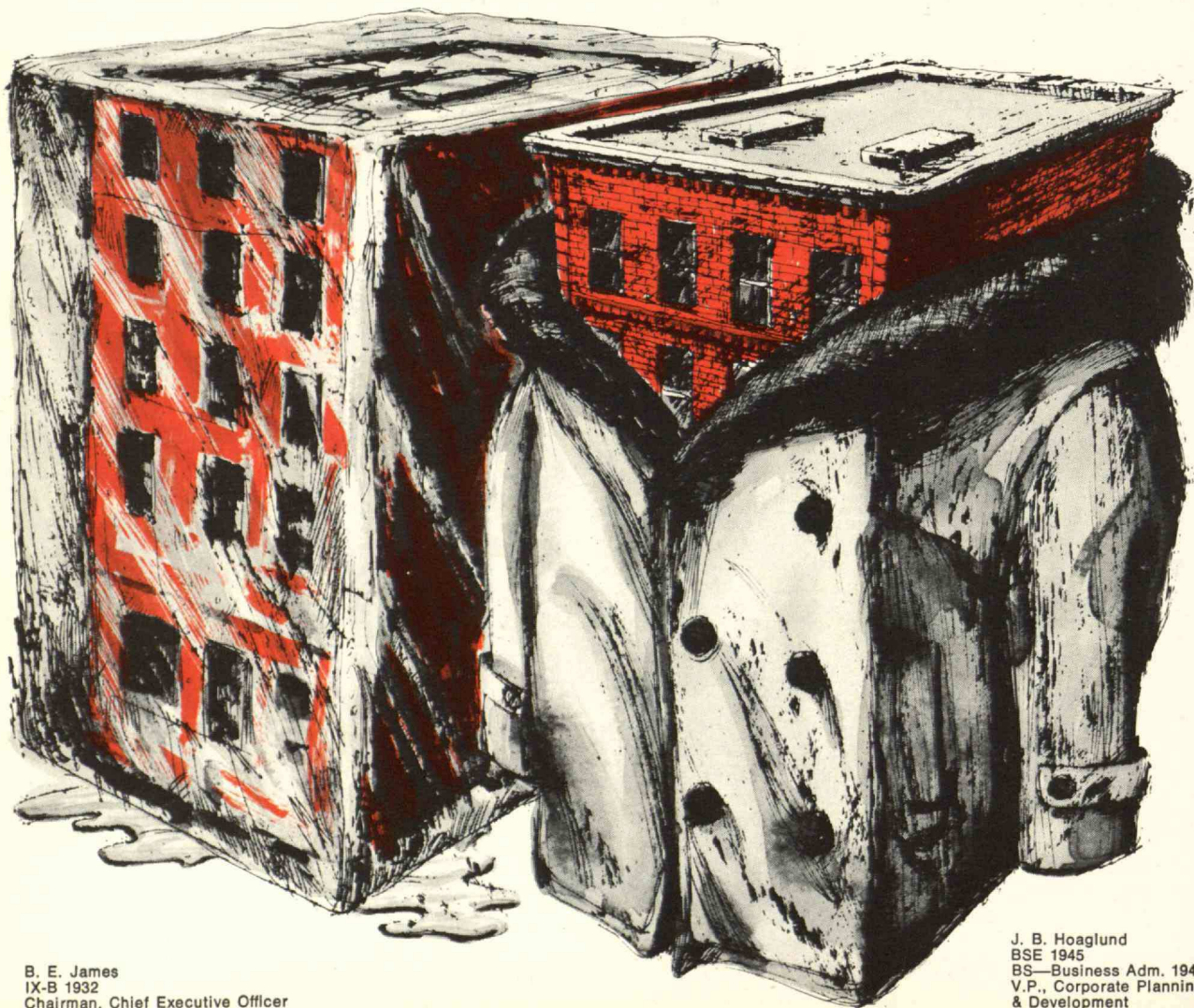
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